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ABSTRACT

The Solid Waste Disposal Act of 1965 (Public Law 89-272, Title II) and its amending legislation, the Resource Recovery Act of 1970 (Public Law 91-512, Title I), authorize collection, storage, and retrieval of information relevant to all aspects of solid-waste management. As part of this effort, the U.S. Environmental Protection Agency's solid-waste management program is updating the "Refuse Collection and Disposal Annotated Bibliography" series, initiated during the early Federal efforts in the 1940's. The present bibliography has been abstracted and is arranged in categories corresponding to the various administration, engineering, and operational phases of solid-waste management. Indices include subject, corporate author, author, and geographical location cited. Addresses of periodical sources are provided in an index. The literature represented does not include all the solid-waste literature published in 1964; 107 periodical and 109 nonperiodical titles covering both foreign and domestic literature were screened for inclusion. No effort was made to separate strictly technical material from that which is more general. (JP)

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# SOLID WASTE MANAGEMENT

## *Abstracts from the Literature*

*1964*

SE 017 232

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# SOLID WASTE MANAGEMENT

## *Abstracts from the Literature—1964*

*This publication (SW-66) was prepared by*

**JOHN A. CONNOLLY *and* SANDRA E. STAINBACK**

U.S. ENVIRONMENTAL PROTECTION AGENCY
1971

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# FOREWORD TO A BIBLIOGRAPHY

Since its beginning a quarter century ago, the Federal program in solid waste management has had a number of organizational aegises as well as several organizational titles. Throughout this development, however, the program has consistently maintained a strong, and what has become a highly characteristic, interest in bibliography--in the world-wide solid waste literature. The present volume is a continuation of that interest and of the solid waste bibliography series initiated in 1941.

--SAMUEL HALE, JR.  
*Deputy Assistant Administrator*  
*for Solid Waste Management*

# SOLID WASTE MANAGEMENT

## Abstracts from the Literature

1964

Within the past few years we have been suddenly awakened to the dangers caused by mismanagement of solid wastes. We are now faced with dealing with past accumulations of waste, and also with the tremendous task of establishing new guidelines and solutions to combat the ever-increasing amounts of waste.

The usual approach to problem-solving is to survey previous work done in the subject area, but early investigators of the solid waste problem soon discovered that there was no central, well-organized source of such information on solid waste management. Efforts to remedy this situation were implemented through the passage of the Solid Waste Disposal Act of 1965 (Public Law 89-272, Title II) and its amending legislation, the Resource Recovery Act of 1970 (Public Law 91-512, Title I), which authorize collection, storage, and retrieval of information relevant to all aspects of solid waste management.

As part of this effort, the U.S. Environmental Protection Agency's solid waste management program is updating the *Refuse Collection and Disposal Annotated Bibliography* series, initiated during the early Federal efforts in the 1940's. The present bibliography has been abstracted and is arranged in categories corresponding to the various administration, engineering, and operational phases of solid waste management. Indices include subject, corporate author, author, and geographical location cited. Addresses of periodical sources are provided in an index. The literature represented herein does not include all the solid waste literature published in 1964; 107 periodical and 109 nonperiodical titles covering both the foreign and domestic literature were screened for inclusion. No effort was made to separate strictly technical material from that which is more general.

This publication is the result of the combined efforts of the Solid Waste Information Retrieval System (SWIRS) and the Franklin Institute Research Laboratories under contracts PH 86-67-182 and PH 86-68-194. SWIRS was also assisted in this project by 1970 summer-student employees: Cynthia Brooks, Susan Brown, and Martha Renner.

--RALPH J. BLACK, *Director*
Office of Technical Information
Office of Solid Waste Management Programs

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## REGULATIONS (including Laws and Ordinances)

**64-0001**
Arizona supreme court rules for private haulers. Refuse Removal Journal, 7(2):4, Feb. 1964.

The Arizona Supreme Court declared that certificates of public convenience and necessity could not be required of motor carriers in the trash collecting business for trash haulers are private, not public, carriers. The decision concluded a series of applications to the Corporation Commission and litigation which began in 1955. The Corporation Commission, in the court's opinion, was unreasonably attempting to grant a monopoly to the appellant's competitors. The Court also pointed out that health regulations were not involved in the case.

**64-0002**
Chicago ordinance confines dumping to landfill sites. Refuse Removal Journal, 7(3):24, Mar. 1964.

Chicago passed an ordinance designed to slap rigid controls on private dumping operations. The ordinance demands a $50,000 indemnifying bond, license fees, regular inspections, daily coverage of refuse, and revocation of permits for violations.

**64-0003**
City without removal ordinance faces epidemic. Refuse Removal Journal, 7(10):32, Oct. 1964.

Texarkana, Texas, which has inadequate refuse removal and disposal facilities, is now facing an outbreak of encephalitis. The carrier of this disease is a mosquito, which breeds in garbage and on animals.

**64-0004**
Edelman, S. Legal aspects of sanitation programs. Public Health Reports, 79(8):676-682, Aug. 1964.

Laws, municipal ordinances, and regulations control activities adversely affecting the environment. Private interests often violate such controls, and conflict with ambiguously defined police power. Resolutions of questions involving constitutional limitations on coercive forces, especially those concerning the enforcement strength of states' and communities' sanitation programs, are discussed. One Supreme Court case considered the collection and disposal problem of garbage and other solid refuse. The court ruled that exclusive franchises for companies to collect and incinerate all refuse from within city limits were legal, since health hazard claims supersede claims of private property rights. Another decision provided that no one has a property right in a public nuisance that is so protected that the community cannot abate the nuisance without compensation to the owner for the value of the property. The court upheld the principle that health hazards can be eliminated without formal hearings, though hearings may be requested later. Similarly, it is legal for proper bodies to improve or remove unsatisfactory property which might endanger public health or safety. Police may establish habitable dwelling standards, but such codes must clearly dictate their requirements and impose a duty to admit inspectors as the result of three cases. On the subject of sanitation inspections, those not for the purpose of obtaining criminal evidence were judged not unreasonable searches. Any such criminal evidence procured without a warrant was not legally valid. Finally, the court determined that lawfully required business records could not be withheld although their contents might be incriminating.

**64-0005**
An editorial: court decision vital to all contractors. Refuse Removal Journal, 7(6):26, June 1964.

The U.S. Supreme Court declared that it would not review a decision by the U.S. Court of Appeals, which held that private refuse contractors are not subject to the Minimum Wage and Hour Law of the Fair Labor Standards Act. The two year history of the case, Wirtz (Secretary of Labor) v. Modern Trashmoval, Inc., in which the defense contended that the company came under an exemption covered by Section 13 of the Act for retail or service establishments, is presented. The decision is praised because it will save contractors money.

**64-0006**

Fletcher, J. G. How Florida's Sanitary District Law has helped Pinellas County. Part 1. Public Works, 95(12):71-73, Dec. 1964.

To provide sanitary service for those people residing outside municipal limits, the Florida State Legislature passed, in 1959, the County Water and Sewer District Law, Chapter 59-466, Laws of Florida, which became 153, Part II, of the Florida Statutes. The Act provides for the creation of special taxing districts within the unincorporated areas of the counties with the purpose of providing a water supply or a sanitary system, or both, as needed by the particular region; the Act further provides for establishment of the districts by the Board of County Commissioners, after the proper legal requirements have been met. These requirements are described in detail, as are the legal experiences of Pinellas County, which was one of the first counties to establish a sanitary district. The establishment of several other districts is outlined and the point made that the Florida State Legislature provided an effective health tool when it enacted this law.

**64-0007**

Justice Dept. indicts refuse association. Refuse Removal Journal, 7(1):16, Jan. 1964.

Attorney General Robert F. Kennedy said that the Philadelphia Refuse Removal Association has been indicted on charges of conspiring unlawfully to fix prices and rig bids for refuse collection and of threatening and harassing refuse removal firms which would not participate in the conspiracy. The indictment charged violation of Section 1 of the Sherman Antitrust Act.

**64-0008**

Krieger, J. H. The law of the underground. Civil Engineering, 34(3):52-53, Mar. 1964.

The three basic functions of groundwater management, water supply storage, and waste disposal, are becoming inextricably interrelated and should be considered as part of a single circulating system. The lack of proper legal measures for pumping water, for utilizing underground storage, and for the discharges of sewage and industrial wastes, is discussed in detail. Suggestions for better coordination of these functions include: (1) cooperation, where conflicts exist between agencies; (2) creation, by state legislatures, of super agencies that would have overriding regional power; (3) action by any state in exerting its authority for the solution of local problems; and (4) an accelerated program by the Federal Government.

**64-0009**

Landlubbers fine liner for littering offshore waters. Refuse Removal Journal, 7(9):58, Sept. 1964.

The Cunard Liner Caronia was fined for littering 3 miles off the New Jersey coast. Although many ships have been suspected, it was the first time a major ocean liner has been observed and accused of littering local waters.

**64-0010**

Latest internal revenue code disallows landfill depreciation. Refuse Removal Journal, 7(8):33, Aug. 1964.

The Internal Revenue Code should contain a depreciation allowance for sanitary landfill projects, just as it does for the mining, oil and gas interests. The initiation of a strong public relations and lobbying program on the part of the private contractors to bring such an allowance about is recommended.

**64-0011**

Legislation dooms dumps in Illinois. Refuse Removal Journal, 7(7):38, July 1964.

Legislation passed at the 73rd session of the Illinois General Assembly and signed into law by the governor makes it unlawful after August 26, 1964, to operate an open dump in which refuse is placed. The law provides that, ''no dump or site for the placing, depositing or dumping of refuse. Any such dump...shall be completely covered with earth''. It further provides for punishment by fine in an amount not to exceed $200 for each offense. Each day of operation in violation of this act constitutes a separate offense.

**64-0012**

Millard, R. F. Legal aspects of public cleansing. London, Institute of Public Cleansing, 1964.

Based on a series of lectures, this monograph covers the section of the syllabus for the Testamur Examinations dealing with public cleansing laws. Part I--England and Wales--contains sections of the following Acts and Regulations: Public Health, 1936 and 1961; Radioactive Substances, 1960; New Streets, 1951; Highways, 1959; Removal of Vehicles, 1961; Housing, 1962; Quarry Fencing, 1887; Local Government, 1933; Agricultural Powers, 1954. Part II concerns Acts of London: Public Health, 1936; The London Traffic Regulations, 1958; Metropolitan Police, 1839; London Government, 1939; London County Council; and By-Laws. Sections from Acts in Scotland are in Part III: Public Health, 1897; Burgh Police, 1902 and 1903; Local Government, 1908 and 1947; Water, 1946; and Glasgow Corporation Consolidation (General Powers) Order Confirmation, 1960. Part IV contains sections of Acts common to all areas: Prevention of Damage of Pests, 1949; Weeds, 1959; Litter 1958; Clean Air, 1956; Truck, 1831, 1887, and 1896; Payment of Wages, 1960; and Explosives, 1875. Sections from Motor Transport and Workshops Acts are obtained in Part V: Road Traffic, 1960 and 1962; Lighting Obligations; Construction and Use Regulations; Petrol Pumps; Weighbridges; Vehicle Painting Regulations, 1926; Cellulose Solutions Regulations, 1934; and Factories, 1961. Appendices to the monograph cover the London Government Act, 1963; and the Offices, Shops and Railway Premises Act, 1963.

**64-0013**
Municipal liability in operation of a village dump. Public Works, 95(1):60, Jan. 1964.

The problem of governmental immunity in connection with municipal liability for torts is much discussed by the courts. In Jollife v. Village of East Troy (Wisconsin, 1963), the city, although engaged in a governmental function, was held liable when a fire on the village dump spread to the plaintiff's barn. This decision was in accord with Wisconsin's abandonment of the governmental immunity doctrine for municipal tort liability.

**64-0014**
Otto, F. Refuse as liability and insurance problem. Technische Ueberwachung, 5(11):421, Nov. 1964.

The disposal of refuse always presents difficulties if the town refuse collection agency is not consulted. Incineration and composting are the only two methods of disposal which are not deleterious to the groundwater. Three liability cases are mentioned. The Water Household Law, Section 22, states that liability is incurred, even if the pollution of the water occurs without conscious knowledge of the act. Natural water which has been polluted by solid material does not automatically become sewage. (Text-German)

**64-0015**
Pennsylvania closes down open dumps. Refuse Removal Journal, 7(10):28, Oct. 1964.

A new Pennsylvania state law, which requires the closing of all open garbage dumps, has caused problems for small towns near Allentown, Pennsylvania. Mayors and councilmen from four towns whose population is about 35,000 and which at present have temporary arrangements with private contractors met to discuss the problem. The state sanitarian proposed either landfill operation or the construction of a cooperative incinerator. The officials decided to hold another meeting before reaching a final decision. They were informed by the State that they have only weeks to comply with the letter of the law.

**64-0016**
Proper storage of household wastes equals labor savings. Refuse Removal Journal, 7(3):30, Mar. 1964.

Passage of an ordinance to assure that house garbage storage is sanitary and can be easily handled by the trash collectors is recommended. The elements such an ordinance should have are enumerated.

**64-0017**
Solid Waste Disposal Act of 1964. Compost Science, 5(1):18-19, Spring 1964.

On April 10, 1964, Congressman John Lesinski of Michigan introduced H.R. 10807 in the House of Representatives. The measure, which was referred to the Committee on Interstate and Foreign Commerce, was a bill to provide research, training, and technical and financial assistance to States for disposal of solid wastes. The text of the bill is provided. The bill's main features include provisions for research and training activities conducted or supported by the Public Health Service; the construction of not less than five composting demonstration plants, plus other municipal refuse disposal facilities; collection and dissemination of information; and rendering of technical assistance to state and local governments.

**64-0018**
Solid waste legislation. American Journal of Public Health, 54(12):2097, Dec. 1964.

The American Public Health Association's recommended federal legislation in the solid waste field is listed. These include enlarged research program, technical and financial assistance, and training of professional personnel in improved programs.

**64-0019**
Supreme Court decision concerning the establishment of a municipal waste removal system. Wasser und Abwasser, 105(20):549-550, May 1964.

In a municipality in Germany there was no type of waste removal system until 1956. Waste was dumped at the roadside. In 1956 a private enterprise was established for removing the waste in that community, but all the municipality had to say about disposal was that it considered the removal and elimination of waste the sole concern of the proprietor of a house, industrial plant, etc. By local statute of Sept. 27, 1960, the municipality set up its own waste removal system which all the members of the community have to use. The owner of the private enterprise sued the municipality and requested a compensation of 10,000 DM. The district court turned down the claim. The court of appeals sentenced the municipality to pay an indemnity of 1,000 DM. The German Supreme Court reversed the decision on the grounds that the municipalities were given the right by the consideration to introduce any facility urgently needed by the public. (Text-German).

**64-0020**
United States tax court rules for depreciation of landfill. Refuse Removal Journal, 7(11):20, Nov. 1964.

The U.S. Tax Court ruled that an owner of a landfill site is entitled to depreciation deductions on the space that is filled each year. The court ruled in favor of John J. Sexton, owner of John Sexton Contractors Company in Chicago.

## FINANCES (including Costs, Fees, Taxes, etc.)

**64-0021**
Caron, A. L. Economic aspects of industrial effluent treatment. Tappi, 47(9):62A, 67A, 72A, Sept. 1964.

The costs associated with various effluent processes for the removal of solids and substances responsible for oxygen uptake in streams are briefly discussed. Only effluents from the pulp and paper industry are considered, and figures given are only estimates. Sewering costs and expenditures for in-plant changes are not included in quoted costs. The first step in effluent purification is the removal of settleable solids; 95 percent of these solids can be removed in a sedimentation unit. To aid the removal of suspended materials, coagulants may be used. Charts show the cost for units up to 150 ft in diameter capable of handling up to 9.6 mgd. Clarifier operations costs are low since little maintenance and low power are required. Useless sludge obtained from clarification can be disposed of by one of three methods: (1) drying in shallow basins; (2) using a vacuum filter; (3) or a centrifuge. The first method costs from $1 to $3 per ton of dry solid. Vacuum filtration costs $350 per sq ft of filter, and centrifuge disposal costs $6 to $9 per ton of dewatered solids. Operational and maintenance requirements for this last type are low; however, installation costs run about $1,500 per hp. When, owing to its low oxygen demand, an effluent of high quality is not produced, secondary treatment is necessary. Oxidation can be achieved through the activated sludge process, biological filters, or aerated stabilization basins. Each method is explained briefly, but in most cases a pilot operation is required to determine specific cost.

**64-0022**
City saves with refuse transfer system. Public Works, 95(9):142, Sept. 1964.

Abilene, Texas, has saved an average of $95.55 per day by adopting a transfer system for refuse removal. Four small and six medium packers travel to the transfer station, where they discharge the refuse through a funnel-like hopper into one of the transfer trailers stationed at a lower level. Remote controls at the station enable the route unit driver to control the starting of the trailer engine and the packing cycle from the upper level. Compressed refuse deposited by route packers is recompressed by the trailer's hydraulic packer plate, which compacts refuse toward the rear of the trailer to make room for additional deposits. When full, the trailer goes to the final disposal area, while a new trailer moves into position and the cycle is renewed.

**64-0023**
Computing the cost of refuse collection. Public Works, 95(8):122-123, Aug. 1964.

At a seminar on Solid Waste Collection and Disposal in 1963 at the University of Wyoming, the Laramie health officer described in detail methods for predicting the overall cost of refuse collection. Assuming a population of 17,500, equipment costs will amount to $14,250 and personnel costs to $62,400 per year. Allowing for miscellaneous expenses of $10,250, the total annual operating cost was established at $87,170. After provisions are made for cost of the disposal area, including land costs, fencing, roads, etc., charges for residences and places of business can be calculated.

**64-0024**
Contractor shaves $270,000 off city's annual trash. Refuse Removal Journal, 7(6):46, June 1964.

When Ottawa Sanitation Services Ltd. became one of the first Canadian private haulers to replace municipal collection in 1960, they reduced annual costs from $947,000 to $677,000 despite a greater population and better service. The greater efficiency is attributed to the company's use of modern machinery and its intricate routing and scheduling of collection.

**64-0025**
Donaldson, E. C. Economics. Discussion of individual plants. In Subsurface disposal of industrial wastes in the United States. U.S. Bureau of Mines Information Circular 8212. [Washington], U.S. Department of the Interior, 1964. p. 9-32.

The costs of waste disposal installations ranged from $30,000 to $1,400,000. Costs varied primarily with depth of disposal well, type of well completion, amount of coring and testing, type and amount of surface equipment required to remove solids and enhance compatibility, pressure required for injection of the liquid wastes, and size of the wellbore and casing. A general estimate of capital costs to be anticipated for an injection well under favorable conditions of well location, drilling, and preinjection treatment of the waste is tabulated. Data secured by visits to industrial plants are discussed in detail and a summary of operating conditions is presented. For each plant, the source and nature of the wastes, surface equipment, well completion, and geology are described.

**64-0026**
East, E. W., and V. Gosling. Work study and incentive bonus as applicable to refuse collection and disposal at Worthing. Chartered Municipal Engineer, 91:53-58, Feb. 1964.

Results are reported on a bonus incentive system based on a work study of a refuse collection and disposal operation. The bonuses for the refuse collectors, for example, ranged from 20 to 50 percent of a base pay. The base pay for collectors was based on a satisfactory working rate of 4.77 hr for each 100 bins emptied. A bonus of 30 percent could be achieved readily and regularly by the average worker. In the refuse disposal department, a reorganization permitted a reduction of workers from 22 to 17. The potential savings were £3,785, or 5.4 percent, in the collection and disposal services. Supervision is necessary to counter any tendency to a lowering of the standard of service. With the bonus payments, it was possible to insure continuity of operation at savings to the town. A study was conducted by a group of consultants to determine the value of a bonus incentive system.

**64-0027**
Erhard, H. The political economy of waste elimination. Staedtehygiene, 15(4):87-89, Apr. 1964.

Comprehensive cost analyses for the elimination of waste for the two Bavarian cities, Schweinfurt and Lindau/Bodensee, are presented. In Schweinfurt the yearly amount of waste is 32,000 cu m of trash and 21,000 cu m of sewage sludge. The results of the cost analysis are presented in a table. The least expensive method is trucking the waste to an abandoned gypsum quarry 17 km away. The costs would have made necessary an increase of the service charges by 62.9 percent. However, with the aim of helping agriculture to replenish the humus content of the soil, a composting plant was built where the non-compostable trash together with industrial waste is burned. Necessary service charge increase is 103.2 percent. The trash is treated according to the Brikollare process. The waste is mixed with sludge and pressed into bricks which dry by capillary action. In the cost analysis for Lindau, composting and incineration are compared. Sewage sludge is considered only in the cost analysis of composting and not of incineration; the cost increase was 283 and 176 percent, for composting 131 percent. Composting of waste benefits the nation by supplying agriculture with soil conditioners. The government should subsidize waste composting by loans without interest for the construction of the facilities. This policy is practiced in the Netherlands. (Text-German).

**64-0028**
Jensen, H. P. Private collections. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.91-97.

Municipalities face spiraling costs of refuse collection and disposal. A number of municipalities have solved their problems to a great extent by turning to private enterprise to handle their rubbish collection and disposal needs. A schedule of budgeted and actual collection costs in Oak Park, Michigan, showing savings with contract collection, is given. One apparently simple solution to this problem of disposal costs would be to convert the waste matter from something that nobody wants and that nobody wants to pay for, into something that people want and that people will pay for. Research along these lines definitely is indicated. The new concepts and modifications in equipment reflect not only the growth but the increasing complexity of the sanitation industry. Everywhere in the country enterprising businessmen are rising to these challenges and in so doing are not only helping themselves but also are helping to gain for the industry the respect it deserves.

**64-0029**
Kingston, G. A. Scrap industry economics. In Iron and steel scrap in the Pacific Northwest. U.S. Bureau of Mines Information Circular No. 8243. [Washington], U.S. Department of the Interior, 1964. p.22-33.

Prices and costs are major determinants in the economics of the scrap industry. The price of No. 1 heavy melting scrap is the pace-setter for the pricing of other iron and steel scrap grades. Scrap prices are established essentially by the consumer. A dealer or broker calls the potential purchaser to see if he is in the market. In addition, the consumer or broker might call the dealer to see what type and quantity are available. The purchasing agent for the consumer indicates the current company scrap need and the price he is willing to pay. If the consumer finds that there are no offers to sell at the price offered, he must increase his offer. There are two principal variables in marketing scrap: (1) the market price of scrap; and (2) the cost of transport to the market. Cost examples are given. Railroad shipping rates from selected points to Seattle, Washington, Portland, Oregon, and Geneva, Utah, are tabulated. For the scrap dealer, the export market has played an important role in creating favorable domestic conditions. Export contracts generally are signed for shipload quantities to be delivered within a given period. This results in a drive to accumulate sufficient quantities, which necessitates a price increase to draw out scrap at distance and to speed up the flow of locally available ferrous scrap. Domestic consumers are caught by the upward price trend and have to pay higher prices to maintain their inventories. The economics of shipwrecking are discussed.

**64-0030**
Lossie, B. Count your indirect costs when pricing customer service. Refuse Removal Journal, 7(2):25, Feb. 1964.

Steps a small trash company should follow are listed. These include pricing its services and counting in the indirect costs, which comprise labor and operating expenses, dumping costs, and a planned profit margin.

**64-0031**

Lynn, W. R. Systems analysis for solid waste problems. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.69-74.

A sample is given of the use of systems analysis in determining the least cost involved in the disposal of refuse using any one of five proposed methods. Comparatively little research has been directed specifically to application of systems analysis to solid waste disposal problems. However, many of the analytical techniques which have been developed for other problems can be applied to this area. Systems analysis provides a tool for examining complex interrelated municipal activities, and the solutions obtained by these methods provide a sound basis for reaching decisions. These analyses are not an end in and of themselves but rather are intended to serve the end of efficient and effective decision-making. Although some of the techniques used in these approaches may be abstract and mathematically complex, the prime motivation for the analysis is to obtain useful results and solutions.

**64-0032**

Middletown bonus scheme success. Public Cleansing, 54(2):733, Feb. 1964.

Middletown, England, which had an undependable refuse collection service that picked up trash from many areas of the town only once every three or four weeks during winter, has greatly improved its service with the help of an incentive bonus scheme. The city also trimmed its personnel and reshaped its routes for efficient weekly pickups.

**64-0033**

New York City budgets 115 million dollars for sanitation. Refuse Removal Journal, 7(6):6, June 1964.

New York City has budgeted over $115 million for the operation of its Sanitation Department for the 1964 to 1965 fiscal year. The department has 14,000 employees, collects 3,700,000 tons of refuse per year, and disposes of an additional 2,000,000 tons collected by private contractors. The disposal is processed by the City's many incinerators or handled by the Staten Island sanitary landfill, one of the largest in the world. The city owns a fleet of barges and tugs, which ship refuse to Staten Island. The metropolis, divided into 57 sanitation districts and 234 sections, is serviced by a fleet of 1,600 refuse packers. The department is sliced into bureaus which deal with such tasks as collection, disposal, maintenance, and training. The department also maintains a library and a museum as well as a large administrative force. Much money also goes into maintaining a snow alert during winter.

**64-0034**

Refuse collection and disposal costs in Detroit. Public Works, 95(9):152, Sept. 1964.

During the fiscal year 1963, Detroit, Michigan, collected 3,117,565 cu yd of refuse and 153,370 tons of garbage. Residential rubbish is collected once in two weeks and residential garbage once a week. The cost for collection and disposal of rubbish was $4.24 per cu yd and for garbage $33.06 per ton. In both cases, collection represented about 80 percent of the total cost.

**64-0035**

Use of computers for refuse disposal methods and costs. Surveyor and Municipal Engineer, 123(3742):59-60, Feb. 22, 1964.

Refuse collection and disposal should be integrated in plans for effective disposal at a minimum cost. Equipment selection and personnel assignment for collection can be readily assessed by a computer. The selection of a disposal system is more complex and must be one which will provide for the community needs in the predictable future for a cost within the financial capability of the community. A reduction in the number of disposal plants and the maximum use of fewer plants of larger capacity may be indicated by the computer. A problem involving 25 refuse collection areas and 18 different possible disposal systems and sites took 37 seconds of computer time to solve and would have required 6 months for one man to obtain the same answer. Computers will provide quick answers to major problems and reduce expensive planning time.

**64-0036**

Uzzle, A. B. Garbage goes under ground to beat costs. American City, 79(2).34, Mar. 1964.

Dunn, North Carolina, buried 55 gal cans with a wire bail to give the appearance of backyard pickup. The cost is only as much as curb pickup.

**64-0037**
Vogel, H. E. Swiss resort towns have higher costs for trash removal. Refuse Removal Journal, 7(11):27, Nov. 1964.

The Swiss Water Pollution Control Association has investigated local conditions of refuse removal in the major Swiss tourist centers. They found widespread indiscriminate dumping of refuse on lake shores, on mountain slopes, and in creeks and rivers. The large influx of tourists during the hotel season and the trend toward urbanization are responsible for the inadequate disposal. There are plans to establish common refuse utilization or incineration plants and to educate the tourists.

**64-0038**
Wuhrmann, K. A. The annual costs of waste disposal. Schweizerische Bauzeitung, 82(44):769-772, Oct. 1964.

Many municipalities are confronted with the task of planning for new, hygienic ways of waste disposal. It is easier to assess the investment costs involved in the new project than the annual costs which include also operating costs. Regarding investment costs, it is difficult to determine the time of amortization, since in some cases a composting plant has been in operation for 50 years, and in others the equipment has had to be modified after a few years of operation. Since technical development in this field progresses so quickly, the fast pace at which the equipment becomes obsolete is an essential factor in determining the time of amortization. Another important aspect is the planned maximum capacity vs. the initial capacity. Calculations should be geared to the present capacity and not to the ultimately planned one. The operating costs need to include personnel, spare parts, improvements, expansions, repairs, power, fuel, water, lubricants, elimination of residues, taxes, insurances, and licenses. An example of annual cost calculation is given.
(Text-German)

## STORAGE (including Methods and Equipment)

**64-0039**
The American tour. Public Cleansing, 54(12):1310, Dec. 1964.

The papers and discussion of the paper sack system at the American Public Works Association Conference are reported. The systems at Manchester, England, and Riverdale and College Park, Maryland, as well as the general status of paper sacks throughout the United States are discussed.

**64-0040**
Bevan, R. E. Manchester's experience with paper refuse containers. In American Public Works Association Yearbook 1964. Chicago, American Public Works Association. p.206-211.

Manchester, England, is conducting a 3-year survey on the potentials of paper refuse containers and concrete stands. In a 3-month study it was found that the concrete stand was preferred by householders as both metal types were blown over by strong winds. A description is given of some of the improvements of the bags used for the first 3-month study. There was a reduction in spillage of refuse during loading and noise was also reduced to a good degree. There was also a reduction in time and effort by the loader, who in the past had to roll and bang the dustbin from house to street. The dustbin weighed 23 lb against the one-half lb of the bags. The cost estimate of the system is also included.

**64-0041**
Bevan, R. E. More paper sacks in Manchester. Public Cleansing, 54(1):646, Jan. 1964.

After a 1961 research experiment, Manchester, England, will gradually expand the paper bag system. The disadvantages encountered in the research were largely eliminated by improved stands and holders and by the addition of animal guard attachments. Some advantages are the absence of dust during loading, the elimination of spillage on pathways and road, the concealment of the refuse, and the silence of the operation. The additional costs of the sacks are broken down. Although tipping sacks seem to present no problem, other methods of disposal need to be investigated in order to discover if sacks would create a problem.

**64-0042**
Black, R. J. Storage in paper sacks avoids rats and flies. Refuse Removal Journal, 7(12):16, Dec. 1964.

Basic factors that determine acceptable refuse storage conditions in a community, including the problem of preventing fly larvae, and different systems of storage are discussed. Perhaps the problem of improper storage could be solved by a community-wide installation of garbage grinders or the provision of suitable refuse containers as an integral part of the regular refuse collection service. Paper bags have justified the latter approach in some cities by reducing collection costs.

**64-0043**
Bower-Butterfield refuse sacks. Surveyor and Municipal Engineer, 123(3759):42, Feb. 1, 1964.

Early in 1964, Binsac, a paper sack household refuse system, was scheduled for marketing by Bowaters, Ltd., and the Butterfield Group. A new 'Mini-Binsac' for indoor use was also designed. A growing interest by potential municipal and industrial users was reported.

**64-0044**
The compression of refuse in multi-story buildings. Public Cleansing, 54(3):794-795, Mar. 1964.

The 'Deva' Compressor, which compresses refuse in paper sacks at basement level of multi-story buildings, is described. Developed by the Hydraulic Engineering Company, Ltd., of Chester, England, it consists of a turntable upon which ten sacks are mounted, a guide tube which directs refuse into the sacks, a block plate, and a pressure plate.

**64-0045**
Connecticut city tests paper bags. Refuse Removal Journal, 7(8):4, Aug. 1964.

In a subdivision of 147 homes in the municipality of Milford, Connecticut, an in-use test program with a new type of refuse collection system has been initiated. The system, called Trim Town, replaces conventional garbage cans with stationary baked enamel finished steel cabinets and disposable heavy-duty bags. A homeowner deposits refuse in the bag through a hinged and gasketed top lid on the cabinet, and the filled bag is removed from the receptacle through a full-length front door. The bags, which are constructed of two plies of wet-strength and water-repellent paper, can be set out in any kind of weather for curbside or backdoor collection. Flat bottom construction lets them stand upright without toppling. The city expects the new system to speed collection.

**64-0046**
Containerized system pays off. Waste Trade World, 105(13):14-15, Sept. 26, 1964.

The Manchester originators of the Beattie system of containerized waste collection and disposal face a problem in dealing with municipal authorities and plant officials because there is no real information available on the cost of the collection and disposal due to poor accounting practices. In industry it is not uncommon to use factory labor to load the waste into 5-ton trucks and charge the labor to production costs. Any 5-ton truck with driver would cost at least £ 60 per month for 20 'lifts' or collections of a waste container. The Beattie system charges include £ 4 a month for the average rent of a container and an average collection charge of £3 10s. This would give the customer disposal facilities for 8 cu yd or 5 tons of material in the case where a container is collected once a week. The containerized service provides the customers with the advantages of hygienic storage, reduced fire risk, elimination of vermin, and labor saving by properly sited containers. The system has handled a variety of material such as paper, cardboard, wire, broken glass, tins, paints, rubber incinerator residues, vegetable matter, and fish waste. With over 40 collections per week for each of seven vehicles in an 8-mile radius, the amount of unrestricted tipping service becomes important, and transfer depots and bulk haulage may become a necessity.

**64-0047**
Cost-cutting refuse disposal. Modern Sanitation and Building Maintenance, 16(12):18, Dec. 1964.

## Storage

A Pennsylvania warehouse now uses steel cabinet receptacles with a hinged, gasketed top lid and hinged full-length door. A heavy-duty kraft paper disposal bag serves as a liner in each cabinet. Previously the warehouse had used swing-top receptacles with metal liners. Removing the covers, lifting and emptying the filled liners, and taking the receptacles to a separate area took 15 to 20 minutes a day. The receptacles were rinsed four times a day and scoured three times a week. The new system of removing a filled bag and replacing it with a clean one takes seconds. The bags are made of two plies of water-repellent and wet-strength kraft paper, making tote containers unnecessary.

**64-0048**
Davies, A. G. Hospital waste problems. Public Cleansing, 54(3):807, Mar. 1964.

Guy's Hospital in Southwark, England, uses the paper sack system of refuse storage. Difficulty with wet kitchen waste can be solved by switching to a bag with a waxed inner lining. Paper bags are expensive, but they are more sanitary and easier to handle than conventional containers. The loaded bags are burned in incinerators adjoining each ward. The possible effects if the system were expanded throughout the United Kingdom are considered. The chute system's adaptability to hospital life and chute sanitation are discussed.

**64-0049**
An editorial. Refuse Removal Journal, 7(7):24, July 1964.

The number of containers in use by private contractors has increased 400 percent over 4 years. This increase in containerization is due to the rise of commercialization and industrialization. Automated collection of refuse represents tremendous savings in time and labor, despite problems which must be solved. The need for containerization will continue to spiral, and more and improved containerization will be needed.

**64-0050**
Ferguson, J. A. The problems of bulk in refuse; Part II, Storage. Presented at Meeting of the Institute of Public Cleansing, Dundee, Scotland, Apr. 8, 1964. 11 p.

General practices of refuse storage in Dundee, Scotland, are reviewed, considering problems involving the size, type, and location of containers. On domestic premises many refuse storage facilities are inadequate, thus prompting a need for enlarged receptacles. However, data indicates that 64 percent of the work performed in refuse collection involves the movement of containers, so that these receptacles should be lighter in weight, too. Plastic bins are considered, as a bin with a capacity of 2.6 cu ft weighs only 8¾ lb. Use of paper sacks is another possibility, although problems of cost and durability arise. In addition, bulk containers should be placed near access roads. Shop refuse has not increased in bulk proportionately with domestic, but many shop premises are designed without sufficient refuse storage provisions. Shop refuse can be stored in interchangeable semi-trailers, bulk containers, dustbins, sacks, cardboard boxes, or bales. Office refuse is of low density--usually clean, dry paper--and can be stored conveniently in sacks. Factories, warehouses, and markets involve storing refuse in bulk, usually in the same ways described for shops. Refuse from hotels and restaurants is similar to house refuse, and licensed premises have negligible storage problems. The main complaint in schools involves the situating of bins near play areas.

**64-0051**
Fire tests rule out combustible containers. Safety Maintenance, 128(3):35, Sept. 1964.

As a result of tests conducted by General Services Administration, combustible trash containers have been ruled 'completely unsatisfactory' for use in all GSA buildings. GSA operates more than 5,000 government buildings throughout the world. In the experiment, flames burned right through nonmetal containers, spilling the fiery contents on the floor; fires in metal containers died out.

**64-0052**
Ford, W., and J. Carswell. It's in the bag for a second city. American City, 79(5):22, May 1964.

Disposable paper bags are now being used in Riverdale, Maryland, in place of garbage cans. Riverdale, with a population of 6,000, is the second city to make the change. The bags have been received with 92-percent favorable reaction by householders. They are suspended from a metal stand, hold twice as much as regular garbage cans, are sanitary, light, weatherproof, and require half the staff and equipment to collect the refuse.

**64-0053**
Form national council to promote paper sacks. Refuse Removal Journal, 7(11):14, Nov. 1964.

The Paper Shipping Sack Manufacturers' Association set up the National Refuse Sack Council to promote the use of paper sacks for refuse storage. Sacks have been cited as successful in Manchester, England, Sweden, and Denmark. They improve sanitation and provide better working conditions for refuse collection employees.

**64-0054**
Fox, G. G. Paper-bag collection on request. American City, 79(10):14, Oct. 1964.

More than one-fourth of the 4,000 residential garbage-collection customers in Camden, Arkansas, elected to pay $0.65 extra per month in order to have paper-bag refuse collection. The Garbax Disposal System, developed by the International Paper Company, utilizes a bag with more than a 30-gal capacity. The system is neat and clean, for the two-ply paper bag is specially treated to hold wet and greasy garbage without rupturing, and no garbage ever touches the metal holder. The City of Camden found the Garbax System to be more sanitary in regard to insect control and odors, and collecting the lightweight bags was a much simpler task than listing the regular galvanized cans. Collection is twice a week, and used bags are replaced with new ones by the collector. Costs to the customer in Camden are included.

**64-0055**
Fox, G. G. Paper bag disposal system finds ready acceptance. Public Works, 95(12):118, 120, Dec. 1964.

A new paper bag garbage collection system, called the Garbax Disposal system, is described. The service was made available in Camden, Arkansas, and was initially subscribed to, on a voluntary basis, by 1,000 customers. The paper bag disposal system consists of a two-ply paper bag suspended in a specially designed holder. The bag is treated to hold both wet and greasy materials without breaking and has a capacity equal to more than a 30 gal galvanized can. The holder is made of heavy duty steel and is designed to surround the suspended paper bag completely. The filled bags are removed twice a week by the collector and replaced by a fresh bag. The price of the unit is $15.00 and the monthly sanitation fee $1.65 as compared to $1.00 for regular collection service. An analysis of the results, as determined by a questionnaire showed that 97 percent of the users found the system more sanitary; 96 percent felt it reduced both spillage and fly and other insect problems; 93 percent reported reduced odor and noise, 100 percent approved of the holder as to appearance; 95 percent approved its durability, and 96 percent reported that the lid stayed tightly closed.

**64-0056**
Hughes, O. G. Refuse storage in multi-story buildings. Royal Society of Health Journal, 84(6):319-321, Nov.-Dec. 1964.

Due to changes in the content of refuse, much planning will be necessary to adapt storage methods to various types of buildings. The British Standards Institution has established refuse storage codes. The need to dispose of refuse quickly has been done in some areas by means of refuse chutes. For example: chutes are adjacent to elevators in Germany and the United States; chutes and central vacuum system are adjacent to stairs in Sweden; and there is chute access from mezzanine landing in Great Britain. To counteract smells and noise, place the chute in a separate room, and avoid depositing hot ashes to prevent fires. The chutes should be straight and discharge vertically over the center of the container. The chamber should be accessible. Sloping curbs prevent bumping containers. One difficulty with sink grinders and the Garchey system is the need to store and collect refuse that will not pass the appropriate sink gauge. Refuse density is 1 ¼ cuts per cu yd. One process employs compression to automatically fill paper sacks with refuse, producing uniform sized and nuisance-free packages.

**64-0057**
Huhs, H. Waste removal--a community task. Staedtehygiene, 15(6):1-4, June 1964.

## Storage

In 1963, the rural community of Ganderkesee in Lower Saxony, population 15,000, established a waste removal service with the paper waste sack system. Participation in the service is compulsory for every household. The annual service charge is DM 9, which covers the cost for the first 18 sacks. Some of the legal background for the regulations is discussed. The paper sacks hold 70 liters and are moisture resistant. They withstand even rain and snow. The sacks are collected by a tractor with trailer and by a horse-drawn carriage. Advantages of the sack system are noiselessness and the fact that unusual amounts of waste, as they occur especially after holidays, are simply taken care of by extra sacks. No case of fire with the paper sacks was reported. The paper sack system appears particularly attractive for rural communities because no specialized waste collecting vehicles are required. (Text-German) (Enclosed Reprint)

**64-0058**
Jay, G. T. The Binrota unit. Public Cleansing, 54(7):1014, July 1964.

The Binrota, manufactured in Great Britain, is a significant step forward in the development of the turntable system of refuse storage. Its chief asset is a lifting mechanism that hauls the containers onto the platform. This solves the problem of water and rubbish spilling into the circular crack between the platform and the floor on the ground-level turntable, and it eliminates lifting heavy containers on the turntable above ground level.

**64-0059**
Kaupert, W. Plastic containers for waste disposal. Staedtehygiene, 15(10):239, Oct. 1964.

The plastic industry is not yet able to produce a material which is not flammable and which holds its shape on heating. The highest permissible temperature is 80 C; for short periods of time the material might withstand 100 C but at any temperature beyond this point it becomes soft and holes develop. One could line the plastic cans with sheet steel which would distribute the heat rapidly but the costs involved are too high. Another serious drawback of the plastic can is that it loses its shape with minor seasonal temperature fluctuations and that the color is attacked by light. Presently Hamburg is engaged in extensive experiments with plastic containers but it is not bound by strict fire prevention rules as is Bavaria, where state authorities decide whether these containers may be introduced or not. (Text-German)

**64-0060**
Kennels use paper sack disposal. Surveyor and Municipal Engineer, 124(3763):68, July 18, 1964.

Sacks of special wet-strength kraft paper in a range of sizes are used by kennels in refuse collection. Because of ease of handling, hygiene factors and saving of labor and time, paper sacks are replacing costly dustbins.

**64-0061**
Kruppe, H. Water protection during waste storage. Technische Ueberwachung, 5(2):69, Feb. 1964.

With the participation of the appropriate authorities and industry, a colloquium was held on October 16, 1963 at Cologne by the Institute for Industrial Water Management and Air Purification on the subject 'Storage of Industrial Wastes.' Reports on the following subjects were presented: (1) the storage of industrial wastes from the legal point of view; (2) the hygienic requirements during deposition of industrial wastes; (3) the hydrological viewpoint during the storage of waste products; and (4) the technological and industrial possibilities of waste storage. During the discussion it was emphasized that the technical and financial problems occurring during the storage of waste of all kinds can only be solved with the cooperation of the town, the community, industry, and the authorities. (Text-German)

**64-0062**
Mortensen, L. Rental containers become a popular item. American City, 79(4):34, Apr. 1964.

The city of Scottsbluff, Nebraska, purchased ten 1½-yard detachable refuse containers and rented them to its business community for $2.50 a month. The containers which are designed to fit various makes of collection trucks, speed up local refuse collection. The system was so popular that the city plans on purchasing more containers next year.

**64-0063**
Municipality of Montclair, N.J., uses paper trash containers. Refuse Removal Journal, 7(2):34, Feb. 1964.

Residents of Montclair, New Jersey, can use a voluntary paper garbage can system at their own expense. Bags cost $.07; wall holders, $5.00; and receptacle holders, a little higher. Residents of College Park, Maryland, have a compulsory paper can program and are supplied paper bags and wall holders free of charge. Past users of the paper cans said they are more sanitary and convenient.

**64-0064**
New system halves Maryland community's collection force. Refuse Removal Journal, 7(5):29, May 1964.

Riverdale, Maryland, has replaced trash cans with paper bags through a town council ordinance. The paper bags are lighter than garbage cans, and hold as much or more refuse. They can be loaded directly into the trucks, eliminating the time and motion needed to empty the cans. Consequently, it was possible to reduce the work force from two trucks and eight men to one truck and four men.

**64-0065**
New waste disposal method in Braunschweig, West Germany. Staedtehygiene, 15(3):78, Mar. 1964.

Because of the great shortage of personnel and the increasing amount of waste, a new waste disposal method has been introduced in Braunschweig, West Germany. Instead of the 110 liter garbage containers, large containers of 3.7 cu m volume are used. By means of a hydraulic tilting device attached to trucks, the containers can be easily loaded and unloaded. (Text-German)

**64-0066**
Newburn puts it in the sack. Public Cleansing, 54(11):1272, Nov. 1964.

Newburn, England, has entered into an agreement with a house construction firm to equip paper sack holders into some new homes. Operation of the system, advantages, and a cost comparison with bins are presented. The city has experienced no difficulty in tipping sacks.

**64-0067**
One route tests paper bags. American City, 79(8):34, Aug. 1964.

In Milford, Connecticut, a test program is being conducted to replace conventional garbage cans with heavy-duty, disposable paper bags. Designed to serve as liners, the bags may be inserted and removed from steel cabinets without moving the supporting receptacle. The bags are water-repellant, noiseless, and sanitary.

**64-0068**
P. S. L. tests of paper refuse sacks in S. and D. 'Pakamatic'. Surveyor and Municipal Engineer, 123(3741):51, Feb. 15, 1964.

The results are given on tests using P. S. L. (Paper Sacks Ltd.) paper refuse sacks in a S. and D. (Shelvoke and Drewry, Ltd.) 'Pakamatic' continuous loading collection vehicle. Sacks of refuse loaded into a 'Pakamatic' were completely destroyed and there was no loss in vehicle capacity with the use of sacks compared to loading of loose refuse. The development of a collection vehicle with shredders means that separation and incineration plants can use the paper sack method of collection as well as composting plants without risk of the machines jamming. The resulting paper shreds did not hinder the manual picking of rags, metals, or the operation of the magnetic separator. The hand-filled sacks used in the tests were 2½ cu ft capacity wet strength capacity.

**64-0069**
Paper sacks for refuse collection. Surveyor and Municipal Engineer, 123(3753):25, May 9, 1964.

Subjects discussed during a joint meeting of the Institute of Public Cleansing and the Association of Public Health Inspectors are reviewed. The advisability of replacing the dustbin by paper sacks for refuse collection and the durability of paper against weather and animals were considered as well as the possibility for removal of the social stigma associated with refuse collectors.

**64-0070**
Paper sacks in the kitchen. Public Cleansing, 54(1):695, Jan. 1964.

In a London restaurant, the sanitary Palfrey Refusak, on its compact Deva stand, is being successfully used. Besides being attractive in appearance and noiseless, the space-saving sacks have eliminated the problem of refuse storage.

**64-0071**
Paper sacks prepared for disposal. Public Cleansing, 54(9):1178, Sept. 1964.

Problems associated with passing refuse-collecting paper sacks through a separation-type refuse disposal plant have been dispelled through recent tests in Great Britain. A packer-loader vehicle collected numerous filled sacks, cutting them all up efficiently. The normal separation process was then conducted with no whole bags evident.

**64-0072**
Park, J. Receptacle Rembrandts. American City, 79(9):25, Sept. 1964.

A novel method of attracting attention to trash cans has been employed by the resort community of Lake Geneva, Wisconsin. Sixteen trash cans have been artfully decorated on all four sides with attractive paintings created by local artists. These attractive trash cans have kept the streets and walks cleaner, because people constantly remember these distinctive containers and their purpose.

**64-0073**
Pascoe, G. and R. E. Lapar. Clearing refuse from storage pit corners. Public Works, 95(6):131, June 1964.

Poughkeepsie, New York, solved the problem of cleaning pockets of refuse from the sides and corners of the storage pit of its incinerator by attaching extension arms to the bucket and crane that fed the refuse from the pit into the furnace.

**64-0074**
Plastic refuse bags. Food Manufacture, 39(2):69, Feb. 1964.

Polyethylene refuse bags, 11 to 28 in. wide and 24 to 39 in. long, are in use for disposing of potato waste and spoiled wraps from food processing. The tough polyethylene bags, completely waterproof and grease resistant, are cheaper than other types of refuse bags and therefore represent an improvement in the efficient disposal of waste from the food production line. The bags are easier to handle than bins and can be fitted in a holder in seconds. The filled bag can be sealed and stored anywhere for convenient collection at a later time.

**64-0075**
The problems of bulk: storage. Public Cleansing, 54(7):1019, July 1964.

A paper presented by J. A. Ferguson at a meeting of the Scottish Centre of the Institute of Public Cleansing is reported. Contemporary storage systems' ability to handle the increased bulkiness of refuse is discussed. For the most part, containers have not changed with the changing nature of refuse and methods of increasing container size without increasing weight, such as plastic containers and the paper sack system are suggested. Bulk containers and commercial, office and factory storage are reviewed.

**64-0076**
Refuse bins instead of refuse barrels. Technische Ueberwachung, 5(3):108, Mar. 1964.

The Braunschweiger town authorities replaced 110 liter refuse barrels with masonry refuse bins with a capacity of 3.7 cu m. Each bin replaced 25 to 30 refuse barrels. The bins are transported three at a time on a truck with a capacity of 5.7 ton and with the maneuverability to turn in small courts and pass through narrow gates. The bins are emptied by hydraulic tilting of the lift tilt platform. Traveling a daily distance of 80-100 km, 2 trucks can transport about 180 refuse bins. This is comparable to the removal of at least 4,500 refuse barrels (110 liter capacity). A supercargo truck which carries 7.65 ton is used for the transport of extra heavy sheet refuse bins, such as those found in parks. (Text-German)

**64-0077**
Refuse sack. Engineering, 198:649, Nov. 20, 1964.

The advantages of paper sacks over dustbins for refuse disposal are briefly discussed.

The sacks are made from two-ply wet strength kraft paper and will hold wet or oily refuse. Holders mentioned ranged from free-standing static or mobile ones to wall-mounted metal ones. The two points stressed are that when the output of refuse fluctuates, sacks are merely changed more or less frequently and that the final emptying requires only one trip.

**64-0078**
Rohe, D. L., H. J. Magy, K. E. White, et al. An evaluation of fly larval migration from containers of combined refuse in the city of Compton, California. California Department of Public Health, Bureau of Vector Control, Oct. 1964. 35 p.

The purpose of the study was to evaluate fly larval migration from refuse containers in a community where wrapped garbage is combined with other refuse, stored in the same container, and collected once-a-week. Refuse containers from 60 households were selected for this study. All households had the following in common: garbage was combined with other refuse; more than one person lived in the household; and the householder was willing to cooperate and not change from his normal practices of refuse disposal. The three test groups differed in the following respects: (1) Group A used an uncovered storage container and had a garbage grinder in use; (2) Group B used an uncovered storage container and did not have a garbage grinder; and (3) Group C used a covered storage container and did not have a garbage grinder. Each group comprises 20 households. The results and recommendations of the survey are presented. The dominance of the two species of green blow flies in the study was of importance because of the rapid development of these species under the summer temperatures in Compton. Larvae emerge within 8 hr of egg deposition. During the summer, larval growth is often completed within 3 to 4 days. The mature larvae then migrate from the refuse container and pupate in the soil prior to the emergence of the adult.

**64-0079**
Second community adopts the paper bag refuse system. Public Works, 95(5):117, May 1964.

The community of Riverdale, Maryland, has adopted the paper bag system. All of the 1100 householders cooperated in a test of the Westvaco system, as a result of observing their neighboring community of College Park during a test of the same system the year before. After a trial period, the town sent cards to solicit reaction of householders to the system. The response was 92 percent in favor. Because of the low cost of the paper bag system, it is being supplied to householders at no cost.

**64-0080**
Shayne, P. E. Containerization. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.80-84.

The number one problem in the container industry today is cleaning the container. Actually local Health Department Authorities hold the customer responsible for keeping the trash containers on his premises in a sanitary condition, but the customer also demands this service of his trash removal contractor. Because of the manpower and the time it takes, cleaning containers raises the cost of the service considerably. Collection trucks, because they represent such a big investment, have to take in about $30.00 an hr. It takes about 5 minutes to clean the container. This costs the contractor $2.50. Three methods are commonly used to clean a container: spraying a disinfectant sanitizer into the empty container; steam cleaning it; or applying hot water and disinfectant with a turbo-like spray. What it really needs is some automatic method of cleaning the container that would be efficient, save time, and eliminate the possibility of human negligence. What is needed is the technique of cleaning and disinfecting containers while they are in a dump position above the truck. Other pertinent problems are also listed. It is believed that all research in the detachable container systems industry, as well as in refuse disposal, needs to be done with the future in mind, and by improving detachable container systems, one necessary step forward will have been taken toward the solution of the whole refuse problem.

**64-0081**
Shayne, P. Expensive cleaning methods slow container process. Refuse Removal Journal, 7(4):35, Apr. 1964.

Six basic types of modern automated containers are discussed. A chief problem such a container presents is the lack of a quick, inexpensive method of cleaning. However, the non-automated containers cause the bulk of difficulties in this area. What is now needed is some automatic method of cleaning containers.

**64-0082**
Waste disposal in hospitals. Staedtehygiene, 15(3):78, Mar. 1964.

Hospitals are turning more and more to the use of paper bags for removing the accumulating waste. Both movable and stationary racks are available, into which the bags may be hung. The bags come in two sizes, 60/70 liter and 110/120 liter. Hospitals prefer the paper bags to sheet steel cans because they can be handled noiselessly and because they are more hygienic. (Text-German)

**64-0083**
Waste disposal unit. Engineering, 197:473, Apr. 3, 1964.

A ruggedly constructed Wastemaster disposal unit with pedal operated lid is described. When the pedal pressure is released, the lid closes, trapping any odors and reducing contamination risk. Another advantage is that the pedal leaves both hands free. Dumping is performed by moving a lever which causes the hinged base to fall away. Dimensions of the sheet steel, zinc plated unit are given. The standard capacity is 17 cu ft.

## COLLECTION AND DISPOSAL–General

**64-0084**
Alter, A. J., and F. Asce. Sanitary engineering in Alaska. Civil Engineering, 34(3):48-51, Mar. 1964.

In arctic engineering, designs have to be subjected to a thermal analysis as well as to the conventional structural, chemical, biological, esthetic, feasibility, and functional considerations. All sanitary engineering design concepts now in use in Alaska for water and sewage works can be roughly divided into three categories: (1) protection from freezing by encapsulation or isolation from damaging temperatures; (2) insulation and heating of facilities wherever they may be located; and (3) utilization of non-frost-susceptible systems. These three methods are discussed in detail. Since there are many unanswered questions concerning arctic water and waste system design, construction and operation, further research is indicated in practically every aspect. Examples are: (1) new concepts of water supply and waste handling are needed; concepts are required that will [illegible] facilities that will provide water [illegible]ble for reuse and to facilities that [illegible]vide improved collection and disposal [illegible]stes; (2) methods must be develop[illegible] the utilization of low temperatures and low temperature phenomena in water and sewage works; (3) community planning concepts suited to the water supply and waste disposal requirements of the Arctic; and (4) concepts for individual housing must be better correlated with the characteristics of the community and utility service needs. Emphasis should be on the use of locally available resources.

**64-0085**
Apply imagination to urban problems. American City, 79(12):86, Dec. 1964.

Speeches delivered at the 1964 Public Works Convention and Equipment Show, included two talks on refuse handling. One outlines the 'do's' and 'don'ts' of specifying an incinerator, and the other presents the pros and cons of vacuumized sweeping.

**64-0086**
Baker, J. S. A cooperative municipal refuse disposal program Prince George's County, Maryland. College Park, University of Maryland, Sept. 1963. 35 p.

A committee was appointed to study a refuse collection and disposal report prepared for the Washington Suburban Sanitary Commission on the Anacostia landfill. The report noted that the expected life of the Commission's Anacostia landfill was only five to six years. This consideration moved the committee to undertake a study of the feasibility of forming a cooperative municipal refuse disposal facility that would be operated by and available to the cities and towns in Prince George's County. The services of the staff of the Maryland-National Capital Park and Planning Commission were obtained for locating possible landfill sites that would conform with regional land use and planning considerations. The problems involved and criteria used in selecting landfill sites are discussed. A detailed description is given of 15 possible landfill sites and estimated costs are tabulated. An automatic data processing system was employed as a computing aid in determining the most economical cooperative refuse disposal program. Two alternatives for refuse disposal other than the formation of a municipal cooperative are given. It is felt that better services can be obtained from a regional agency than can be provided independently or through a cooperative arrangement. Thorough evaluation of the composting method of disposal is suggested.

**64-0087**
Baker, J. S. Planning a cooperative municipal landfill. In A cooperative municipal refuse disposal program Prince George's County, Maryland. College Park, University of Maryland, Sept. 1963. p.5-11.

A problem associated with developing a cooperative municipal landfill program is that landfills are limited to fixed geographic locations that must meet a number of rigid criteria. The physical location of a possible landfill site becomes a limiting factor as well as the charges for the disposal at the site. The approach taken in this study was to consider the possible use of several landfill sites and to investigate the use of an incinerator and several refuse transfer stations on a cooperative basis. The possible use of the composting method was also investigated. Several private firms were asked to comment upon the feasibility of establishing composting plants in Maryland. The criteria used in selecting possible landfill sites eliminated any site that would not serve a population of 15,000 for at least ten years (a total fill volume of 150 acre-ft). At least one acre of the site should be considered unusable for filling because of land requirements for buildings and roads. The location of landfill sites on public lands is highly desirable and every effort should be made to locate landfill sites that might allow the reclamation of public lowlands for recreational or other uses. Other factors of importance are the geological formations underlying the proposed landfill site, and the soil and drainage characteristics of the site.

**64-0088**
Baker, J. S. Preliminary site locations. In A cooperative municipal refuse disposal program Prince George's County, Maryland. College Park, University of Maryland, Sept. 1963. p.12-17.

Fifteen sites that may be suitable for use as sanitary landfills were indentified. A detailed description of each site is included. The larger landfill sites are privately owned and are located, generally, to the south of the majority of the cities and towns included in the study. Landfill sites owned by public agencies are generally smaller, but are located closer to the population centers than the larger sites. The costs of purchasing privately owned land was estimated to be high, in some cases as much as $40,000 per acre. Estimated costs of refuse disposal for each potential landfill site under various degrees of utilization are tabulated. The estimates include the following cost factors: labor for weighing, compacting, covering and supervision; the cost of maintenance, repair and operation of equipment; the cost of utilities including telephone, heat, light and water; amortization of the costs of initial land development, original equipment purchases, and the cost of purchasing the land; sinking fund requirements for the replacement of equipment; administrative costs. Cost projections were also prepared for an incinerator and for operating two transfer stations and are tabulated.

**64-0089**
Baker, J. S. Designing the cooperative program. In A cooperative municipal refuse disposal program Prince George's County, Maryland. College Park, University of Maryland, Sept. 1963. p.18-30

Automatic data processing systems were employed as a computing aid in determining the most economical cooperative refuse disposal program possible within the alternatives available. Descriptions of the problem and of the instructions given the computer for solving the problem are presented. The results of the first cycle are of significance only if a regional agency, such as the Washington Suburban Sanitary Commission or Prince George's County, owned and operated the sites selected, made the sites available to private collectors, and the sites were used to near capacity. The results of the final cycle indicated the formation of four separate cooperatives with disposal costs for various landfill sites varying from $1.64 to $2.39 per ton. The criteria used were selected with a view toward providing for the maximum utilization of each of the most desirable landfill sites. The smallest cities were removed until the landfill utilization equaled or was slightly less than the full capacity of the landfill site. The first step in the formation of a cooperative would be appointment of a committee or board, consisting of representatives from each of the cities considering participation in the cooperative, to study the feasibility of such a program. One method for sharing the costs of a cooperative landfill is to distribute the initial and operating costs on a population basis. Using the example of the cities that might form a cooperative with a particular landfill site, a breakdown of costs for each city is presented.

**64-0090**

Baker, J. S. Alternatives to a cooperative program. In A cooperative municipal refuse disposal program Prince George's County, Maryland. College Park, University of Maryland, Sept. 1963. p.31-33.

The two basic alternatives for refuse disposal other than the formation of a municipal cooperative are: utilization of refuse disposal facilities provided by a regional agency such as the Washington Suburban Sanitary Commission or Prince George's County; or establishment of refuse disposal facilities on an individual city basis. The Washington Suburban Sanitary Commission has given no indication of an intent to abandon its refuse disposal functions in Prince George's County. Cities and towns could work toward an improved regional refuse disposal program by urging the regional agency to establish several disposal sites at convenient locations throughout the County. The regional approach should not exclude the active participation of municipalities in the formation of policies and operating procedures. Some cities may wish to continue operating their own refuse disposal facilities or to use private facilities. As the metropolitan area expands and landfill sites are depleted, however, continuation of independent landfill operations will become less feasible. Generally, the use of independent refuse disposal operations will be limited to cities located on the outer fringe of the metropolitan area.

**64-0091**

Barton, A. E. Labour relations in public cleansing in Great Britain. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 13 p.

The history of public cleansing in Great Britain is traced. Comparative pictures and job descriptions of the refuse collector in 1900 and in 1964 are provided. The numerous old and worn out workers on the Cleansing staff in the early 1900's are noted. A great part of the work had to be done at night and there were complaints on the way men carried it out. The attire of the refuse collector with his horse-drawn vehicle is described along with his typical duties. A 53 to 60 hr work week was common. No social security or welfare benefits were available. The dustman had to be a tough character to accomplish this dirty and physically demanding job which lacked present-day standards and innovations. The wage increases through the years are shown, as are the decreasing hours of work for the various job categories. 'Joint consultation' which enabled the employed and employee to work together for their mutual benefit, has been used in industry but has not been common in Public Cleansing Departments in Great Britain. The author describes two Joint Consultative Committees he has been instrumental in forming. Each committee, made up of representatives of all sections, meets the Head of the Department and his principal officers at monthly meetings. The influence of mechanization upon Public Cleansing is reviewed. Training courses enable promotion to a higher paying job. The various forms of social security and welfare benefits, including sickness and disablement insurance are described. Trade Union membership is either compulsory or desirable as it is thought to have been instrumental in securing better working conditions and welfare provisions.

**64-0092**

Bell, J. M. Development of methods of sampling and analyzing municipal refuse Purdue University 1957-1962. Lafayette, Ind., Purdue University. 18 p.

The first two years of this project dealt principally with various sampling methods for determining the composition of a large quantity of refuse such as a truckload of 8,000 lb. Results indicated that one has 95 percent confidence of being no more than 20 percent in error by analyzing a quarter of a truckload of refuse when estimating such parameters as percent by weight, percent by volume, bulk density, percent moisture, percent ash, and calorific value of the garbage, combustible, and non-combustible portion of the refuse. Also included in the first 2-year study was a sampling procedure in which samples were obtained on a household basis in order to show the variation in quantity and quality of refuse from individual households throughout a homogeneous residential area within a community. A statistical analysis of the data gave some idea of the necessary number of households to be sampled in a homogeneous area of a community in order to obtain a desired accuracy with a certain percent confidence. Field studies were conducted in order to obtain samples of refuse for laboratory analysis as well as to estimate the accuracy of the method used in obtaining the samples. A special study was conducted in the early part of the project in order to obtain information concerning the laboratory technique of drying and grinding refuse samples prior to subsequent chemical analyses. Recommendations for future research are given.

**64-0093**
Black, R. J. A preliminary report on the proposed plan to dump refuse at sea by the City of San Juan, Puerto Rico. U.S. Public Health Service, Mar. 1963. 14 p.

Pertinent information was assembled to evaluate the proposed plan of the City of San Juan to dump its refuse at sea. Present disposal methods used by the city and ocean disposal of refuse by other cities were considered. Length of ocean haul and docking and loading facilities were studied. The City of San Juan is now collecting an average of 662 tons per day of refuse. Although crushing or baling would add approximately $0.80 to $1.00 per ton to the cost of refuse handled, such processing might be worth the additional costs provisions, to reduce floatage problem. Tentative contract provisions, to be reflected in private contractors' offers, are critically examined. It was generally concluded that the dumping of refuse at sea would provide the city with inexhaustible refuse disposal facilities at less cost than other available methods. Total costs are expected to range from $2.00 to $3.00 per ton for quantities of 500 to 600 tons per day. It was recommended that wind and current conditions be observed, transfer structures and buildings be made of concrete or brick, alternate disposal facilities be provided, and wood and similar floating materials be disposed of at a landfill. Since the city would be forced to operate landfills for at least a sizeable portion of its refuse, suitable lands should be acquired and reserved.

**64-0094**
Black, R. J. The solid waste problem in metropolitan areas. California Vector Views, 11(9):51, Sept. 1964.

The magnitude of the present solid waste problems in urban areas is emphasized. The local government outlay for refuse collection and disposal, over $1.5 billion, is exceeded only by expenditures for local schools and for roads. The private sanitation industry also expends about $1.3 billion additional yearly. Major problems discussed include the population explosion; increasing per capita rate of refuse production; scarcity of land for sanitary landfill; pollution from open dumps; high citizen apathy; air and water pollution; vector control; occupational health; accident and fire prevention; continued, unlawful feeding of raw garbage to swine; and high accident rate of sanitation workers, twice that of policemen and firemen. The author recommends much research in collection methods, since 85 percent of the disposal cost is in collection. State legal authority to provide area-wide refuse service is badly needed, and has been provided in only nine states. Legal action coupled with the growing body of technical information should enable more cities to cope effectively with their solid waste problems.

**64-0095**
Bugher, R. D. Progress begins with research. APWA [American Public Works Association] Reporter, Apr. 1962. 1 p.

This editorial points out the concern of the American Public Works Association over the fact that very little money is going into the field of research for development of improved methods of collection and disposal. Therefore, the A.P.W.A. has attempted to alleviate this problem by publishing a book on Refuse Collection Practice and by requesting the Department of Health, Education, and Welfare to establish a broad program of basic and applied research in this particular field of activity. The organization notes that legislation is now in action to support the kind of program that is really needed. One study now being conducted by the U.S. Public Health Service proposes: (1) to dispose of wastes through chutes connected to a system of vacuum tubes; (2) to compress refuse into reusable briquettes; and (3) to use mathematical models to determine the optimum refuse collection system in specific areas.

**64-0096**
California State Department of Public Healthh. Environmental health survey for the Santa Rosa area. Sonoma County, Calif. Cincinnati, U.S. U.S., Public Health Service, Aug. 1963. p.1-76

Health, planning, public works, and housing personnel from Sonoma County and seven surrounding countries attended a course on Urban Planning for Environmental Health. A survey of the Santa Rosa area was conducted, findings were evaluated, and group reports were written. The reports cover water, sewerage, refuse collection and disposal, air pollution control, housing, general environmental health, vector control, and planning. Recommendations for improving the environmental health of the community are listed and a program of implementation is summarized. A roster of student and staff participants is appended.

**64-0097**
California State Department of Public Health. Refuse collection and disposal. In Environmental health survey for the Santa Rosa area. Sonoma County, Calif. Cincinnati, U.S. Public Health Service, Aug. 1963. p.29-35.

Private companies operate under contract or franchise to the individual cities to provide regular refuse collection service. Refuse collection in Santa Rosa is a mandatory service for which $1 is automatically charged on each water bill. Domestic garbage is collected weekly and each household is provided free curb collection of 1 cu yd of refuse weekly. Packer trucks are required for the collection of garbage while open vehicles are used for refuse collection. The county provides seven disposal sites containing 97 acres of disposal area but having an average life expectancy of only 4 to 5 yrs. Twelve ft deep trenches are dug and designated for public or commercial disposal and salvage. The refuse, after burning, is compacted with bulldozers and covered with a dirt layer every 48 hr. It costs the county 15 cts per cu yd of uncompacted refuse to operate the disposal site. Sixty-five percent of the operational costs are covered by disposal and license fees. The refuse is not covered often enough to prevent fly breeding and the burning phase causes some air pollution. The uncovered refuse provides nests for many vectors and the salvage pile is unsightly. Special problems are created by the waste of the fruit processing plants. By relating the refuse disposal plan to the general plans it might be possible to create sanitary landfills on land that can be reclaimed for future use, such as park sites.

**64-0098**
California State Department of Public Health. Vector control. In Environmental health survey for the Santa Rosa area. Sonoma County, Calif. Cincinnati, U.S. Public Health Service, Aug. 1963. p.57-61.

In two resort areas, most of the garbage cans were uncovered and there was a less than satisfactory system of cleaning the cans. A tannery proved to be a major source of fly breeding due to poor sanitation practices. Neither of the two county dumps had adequate vector control. Investigation of chicken and cattle ranches revealed excess storage of manure. There is a definite vector problem in the central section of Sonoma County. The legal right to control vector problems is derived from two types of statutory provisions: those relating to the control of public nuisances and those relating to the control of communicable diseases. What is lacking is adequate finances.

**64-0099**
California State Department of Public Health. Environmental health survey Greater Santa Cruz. Santa Cruz County, Calif. Cincinnati, U.S. Public Health Service, Dec. 1963. 74 p.

Health, planning, public works, and housing personnel from Santa Cruz County and six surrounding counties attended a course on Urban Planning for Environmental Health. Many hours were spent in and out of class assembling and evaluating findings, writing group reports, and preparing recommendations. The reports covered water services, sewerage control, housing programs, environmental health programs, and planning. A list of references and a roster of staff and student participants is appended.

**64-0100**
California State Department of Public Health. Refuse collection and disposal. In Environmental health survey Greater Santa Cruz. Santa Cruz County, Calif. Cincinnati, U.S. Public Health Service, Dec. 1963. p.37-40.

Weekly refuse collection service is mandatory in the city of Santa Cruz for all of the incorporated area. The service consists of weekly backyard pickups of one 30-gal can of garbage and one 30-gal can of rubbish. The fee for this service is $1.40 per mo for each premise. The city uses seven radio equipped packer-type trucks for this service; also two open-type trucks are available for rubbish during seasons of heavy needs; 1,181 commercial enterprises are also served by the city but the pickups and charges are on the basis of frequency of collection and volume of material. In some cases, the city is using bulk bins of 1 and 2-cu yd capacity for commerical accounts. There is one disposal site approximately 4 miles west of the center of the city containing 150 acres. The site was operating at a cost of 39 cents per cu yd of refuse in 1962. During the summer months, landfill is practiced. During the winter months, some burning is done. There have been instances where streets and public places have been littered with refuse, presumably by persons outside the city who do not have refuse collection service. It is recommended the acquisition of additional disposal sites be considered. A study should be made to consider increasing the amount of rubbish collected from each premise beyond the present limitation of one 30-gal can per week. Street sweepings containing organic material and waste building materials should not be accumulated near the sewage treatment plant.

**64-0101**
California State Department of Public Health. Environmental health survey of the Chico area, Butte County, California. Cincinnati, U.S. Public Health Service, Sept. 1963. 71 p.

Health, planning, public works and housing personnel from Butte County and 23 surrounding counties attended a course on Planning for Environmental Health. A survey was conducted of the Chico area, the findings were evaluated, and group reports were written. The reports covered water services, sewerage services, refuse collection and disposal, air pollution control, housing, general environmental health, vector control, and planning. A brief profile of Butte County is presented and a roster of staff and student participants is appended.

**64-0102**
California State Department of Public Health. Sewerage systems. In Environmental health survey of the Chico area, Butte County, California. Cincinnati, U.S. Public Health Service, Sept. 1963. p.23-28.

A new treatment plant, serving a present population of 16,000, consists of the following units: headworks, clarifier, sludge digester, sludge drying beds, and percolation and stabilization ponds. The sludge digester is 60 ft in diameter and has a total volume or 454,700 gal. It is capable of serving a population equivalent to about 25,000. The sludge drying beds are 16,000 sq ft in area and have been used very little up to the present time. There are four ponds with an approximate total area of 102.7 acres. No city ordinance exists pertaining to the discharge of industrial or commercial wastes to the sewers. It is recommended that the City develop plans for the time when they can no longer dispose of their sewage on the property they presently own. The Health Department should be consulted before any sludge from the treatment plant is used on city parks. Laboratory facilities at the plant should include facilities for testing dissolved oxygen, sulfides, and detergents.

**64-0103**
California State Department of Public Health. Refuse collection and disposal. In Environmental health survey of the Chico area, Butte County, California. Cincinnati, U.S. Public Health Service, Sept. 1963. p.29-33.

Within the corporate limits of Chico, six private scavengers are licensed to collect refuse. To pick up one 32 gal can per week, the maximum chargeable rate is $1.25 per month. Inside the city, leaves and lawn clippings are removed by the city on those streets were pavement extends curb to curb. Garbage disposal units are allowed to be installed in both city and county areas.

Incinerators are permitted within the city subject to fire department regulation. The primary city-county disposal area is 3 miles east of Chico and consists of 10 acres of land. Maintenance of the city-county site costs from $2,000 to $2,500 per yr which is split evenly between the agencies. Burning is constant and as an open disposal area it was found to be deplorable. It is recommended that the site should be immediately cleaned up and abandoned or converted to a sanitary landfill. Twice weekly pickups of garbage should be mandatory during warm weather. The feeding of garbage to hogs should be eliminated or conform to state laws.

**64-0104**
California State Department of Public Health. Vector control. In Environmental health survey of the Chico area, Butte County, California. Cincinnati, U.S. Public Health Service, Sept. 1963. p.52-57.

Present responsibility for vector control rests with two agencies--the Butte County Mosquito Abatement District on mosquito control and the Butte County Health Department handling most other vector control problems. The city dump revealed an ideal situation for a large rodent population. Maintenance of the present municipal refuse disposal site allows incomplete burning of organic matter which provides media for fly breeding. In recent years, wastes from walnut packing operations have produced large numbers of flies. A feasibility study should be undertaken of consolidating the three mosquito abatement districts of the county. Plans should be made now for an intensive flea and rodent control effort on the existing dump site prior to its abandonment.

**64-0105**
A cleaner Falkirk. Public Cleansing, 54(4):866-867, Apr. 1964.

The annual report on refuse collection and disposal of Falkirk, Scotland is reviewed. A new Lacre Vacuum Sweeper combined with a system of street washing has improved street cleaning. The issuance of dustbins under a Municipal Scheme has improved the storage and collection of refuse. The city has tested household refuse in its composting plant and has found that such refuse compost is satisfactory.

**64-0106**
Collect 12,000 tons of refuse monthly from resort city. Refuse Removal Journal, 7(9):26, 60, 68, Sept. 1964.

Atlantic City, New Jersey, generates 12,000 tons of rubbish each year, not including garbage. The collection of rubbish from the city's beach, boardwalk, households and commercial enterprises is outlined. The city operates a sanitary landfill and an incinerator, which burns 300 to 400 tons of combustible refuse per 24 hr.

**64-0107**
Creisler, J. Tidal wave creates sanitation problems. Public Works, 95(12):68-70, 138-142, Dec. 1964.

Sanitation problems connected with damage done by the tidal wave which hit the coastal town of Crescent City, California, as a result of the Alaskan earthquake of 1964, are discussed. The job of cleaning up was done in three phases: (1) securing of the area and posting quarantine signs on all food establishments; (2) cleanup of debris, destruction of damaged buildings and removal of public health hazards by local agencies; (3) similar action by the U.S. Army Corps of Engineers. The local agencies began their phase of the work as soon as the area was safe; the U.S. Army Corps of Engineers moved into the area 8 days after the seismic sea waves hit. Since the city water supply and sewage system remained intact, the main sanitation problems were debris removal, control of damaged foodstuffs and liquor, and determining the public safety aspects of buildings damaged by the tsunami. The methods used to resolve these problems are described in detail, as are special problems such as the obtaining of disposal equipment, systematic inspection and marking of damaged buildings, and the legal aspects of the problem. The need for and use of law enforcement personnel during all phases of the sanitation program are stressed. Six weeks from the day the tsunami hit, the cleanup work was finished and the sanitation program completed.

**64-0108**
Daily collection of 25 million lbs. creates problem for Ohio. Refuse Removal Journal, 7(11):26, Nov. 1964.

The State generates 25 million lb of refuse daily and spends $35 to $40 million annually for its collection and disposal. A pronounced trend is the steady and constant change in the nature of the refuse. There is a decrease in the per capita production of garbage and ashes and a corresponding increase in rubbish. House containers and three types of collection service in general use--private hauling, contract collection, and municipal collection are discussed.

**64-0109**

Dateline: Vienna. APWA [American Public Works Association] Reporter, 31(9):10, 18, Sept. 1964.

Some of the technical papers presented at the Vienna Congress of the International Public Cleansing Association are reviewed. Alan E. Barton of England reported on the improved working conditions provided for refuse workers. Minoru Shirakawa reported on public cleansing practices in Japan. Some of the refuse is now being collected from plastic containers instead of the open wooden boxes formerly used. The water content of refuse in Japan ranges from 40 to 80 percent; most of it is used for sanitary landfill, some is turned, and a small portion is used for making compost. There are 20 composting plants in Japan producing about 600 tons of compost per day. Unfortunately the market for compost is not very good in Japan. Franz Fischer of Austria presented a paper on the new 600 ton per day Von Roll incinerator which was placed in operation in Vienna in May, 1963. He described a method and calorimeter developed for the determination of the calorific value of refuse. R. Dijkshoorn of the Netherlands presented a paper on a large centralized incinerator to be constructed in Rotterdam. Studies are now underway in Germany and Switzerland on the effect of incombusted incineration residues on groundwater. W Kaupert of Germany discussed the various types of refuse collection equipment utilized by German cities. Pneumatic tipper and the various hydraulic bin-tipping devices now in use have replaced strenuous manual loading. O. Tope of Germany reported on the wide variety of mechanical equipment that has been developed for street sanitation work.

**64-0110**

DeKalb County, Georgia, Board of Commissioners. Sanitary operations. Atlanta, Ga., International Incinerators, Inc., Dec. 1963. 23 p.

The growth of the DeKalb County, Ga., sanitary department and the history of the county's first incinerator are reviewed. The incinerator has a capacity of 150 truckloads and its furnaces maintain controlled heat between 1,400 and 1,800 F. Two rotary ovens have a capacity for burning 300 tons per day of refuse. Smoke passes into a mixing chamber where water is sprayed through 20 separate nozzles, picking up soot, ashes, and other impurities. Residue from the kilns is picked up by trucks for storage or immediate use. The county expects to salvage and sell between 20 and 25 tons of metal collected daily from the incinerator. A study was made of refuse preparation, storage, collection, transportation and disposal in the county, plus the existing Sanitary Division problems and the recommended solutions. To alleviate the unsatisfactory past operations, the County Board of Commissioners adopted a new Sanitation Ordinance. The Ordinance is presented in full. Collection practices were modified, short and long range transportation plans were made, and the DeKalb County Sanitary Division was reorganized. An organization chart and description of the Sanitary Division are included.

**64-0111**

Deming, G. H. Professional training for solid wastes management (public cleansing) in Great Britain and other European countries. Public Health Service. Washington, U.S. Department of Health, Education, and Welfare, 1964. 63 p.

Although the amount of refuse to be disposed of and the problems connected with its disposal are both increasing yearly, the development of skills and manpower needed to deal with the situation are not keeping pace. The consideration of these problems together with the realization that significant progress has been realized in Great Britain in the training of public cleansing personnel, led to the initiation of this study. The British experience is examined from the standpoint of training opportunities offered by higher educational institutions, the growth of professionalization in the field of public cleansing, the role in The Institute of Public Cleansing and the national ministries, and the elements of job satisfaction. In addition, some observations are noted with respect to training in other European countries. The British experience may have utility for those in the United States who are concerned with the provision of academic curricula and training facilities designed to meet manpower needs in solid wastes management.

**64-0112**

Dietrich, D. Ephrata, Washington decides to 'do something' about its garbage disposal problems. Western City 40(11):34, Nov. 1964.

At Ephrata (7,000 pop.) the 3 man municipal sanitation crew offers weekly pickup at $1.50 per month. Commercial areas are serviced more frequently and at a higher rate. All refuse cans (there is no limit to number) are required to be placed on elevated racks 18 in. above the ground. If there are any violations of any of the sanitary requirements, a bright red warning tag is left. The crew uses a 20 yd Garwood packer for pickup and a Caterpillar 955H Traxcavator at the landfill. Cleaning and maintenance of equipment is performed on a regular schedule. The crew is fitted with white uniforms to present a good appearance to the public. At the landfill, rotation of two trenches allows clean dumping facilities each day. Although there is unlimited public use, they allow no scavenging.

**64-0113**

Dodson, J., and H. Wallman. Research on a waste system for aerospace stations. Technical Report AMRL-TDR-64-33. Ohio, Aerospace Medical Research Laboratories, Air Force Systems Command, Wright-Patterson Air Force Base, May 1964. 73 p.

An engineering evaluation was conducted to select an optimum waste management system for collection, storage, and/or disposal of feces and urine in a space station under weightless conditions. Based on this study, a detailed design of an optimum waste management system was prepared for a 7-man, 15-day mission. Tests performed on a breadboard model of the feces collector demonstrate the feasibility of the selected approach. The optimum waste management system is based on separate collection of urine and feces. The feces are collected, stored, and partially dried by space vacuum in one piece of equipment; urine is collected in plastic urinals, sterilized, and transferred to a diaphragm-type, spherical, storage tank for intermediate storage prior to water recovery, treatment or disposal. Tests performed on the breadboard model demonstrate the feasibility of the recommended approach with regard to: (a) lack of pressure buildup with partially dehydrated feces, (b) satisfactory odor removal from recycled air, and (c) complete bacterial removal from vented gases.

**64-0114**

An editorial. Refuse Removal Journal, 7(10):12, Oct. 1964.

The United States spends $3 billion annually to collect and dispose of solid wastes, but only $200,000 on research in solid wastes. This compares unfavorably with the percent of gross that private enterprise sets aside for research. The shortcomings of the current ways of disposing of wastes, and research into the possibility of reclaiming garbage and rubbish by extracting the basic chemical components, not just by salvaging the non-combustibles are discussed.

**64-0115**

Eldredge, R. W. 1963 Refuse disposal study St. Joseph County, Indiana. Chicago, U.S. Public Health Service, 1963. 37 p.

Public Officials requested the Indiana State Board of Health and the U.S. Public Health Service to study the refuse collection disposal practices in St. Joseph County and make recommendations for the improvement of service. Results of a field survey showed that the majority of solid waste disposal sites were operated as open dumps. Alternative methods of waste disposal were investigated. County-operated sanitary landfills were recommended. An ordinance to regulate sites and methods was also strongly recommended. The ordinance should contain minimum standards for operation of sanitary landfills and incinerators. Allowance should be made for any new or improved methods of refuse disposal. Location of sanitary landfill sites should be cooperatively selected so that maximum usage can be made of the finished fill by park, industrial, or recreational facilities. Incineration should be considered only when available sanitary landfill sites are too remote for economical transportation of refuse.

**64-0116**

Franborough. Public Cleansing 54(1):670, Jan. 1964.

According to its annual report on refuse collection and disposal, Farnborough, England, was hampered by severe weather, an increase in work from new development, and a shortage of labor due to sickness among personnel. In addition, the existing tipping area will be exhausted by the end of 1964; a joint neighboring program with neighboring communities is recommended. Salvage collection is profitable.

**64-0117**
From kitchen sink to refuse tip. Surveyor and Municipal Engineer, 124(3766):47-48, Aug. 8, 1964.

A commercial system for the disposal of household waste is described. Normal refuse such as bottles, cans, cartons, and kitchen waste are disposed of through the kitchen sink and flushed by normal waste water into a collecting basin from which it is removed mechanically by tanker vehicle to the municipal dump. The trap and waste tube are specially designed to accommodate objects such as bottles and cans. From the time the waste is placed in the sink until it reappears at the dump, it is unseen, untouched, and without an offensive odor. There are no moving parts, electrical devices, or grinders. The collection tankers empty each collection chamber of both refuse and water by vacuum. The water is removed by squeezing with hydraulic pressures up to 1,000 psi inside the tanker and drained to the sewer through a one-eighth in. screen. The system is especially adapted to use in high-rise apartment houses if installed during construction, but it can be placed in existing buildings.

**64-0118**
The golden yellow hearse. American City, 79(3):26, Mar. 1964.

A golden yellow dead-animal truck responds to calls to collect large animals that die in New York City. The average week consists of six carcasses, most of them horses. The completely enclosed truck features a large tail gate that acts as a ramp when folded down. After the sanitation men attach one end of a cable to the unfortunate animals' hind legs, a winch in the back of the truck pulls it into the enclosure. The carcasses go to a rendering company nearby which salvages them for glue, fertilizer and hides. After a thorough cleaning, the truck gets sprayed with a sweet-smelling substance.

**64-0119**
Gordon, M. Sick cities. New York, Macmillan, 1964. 366 p.

The problems of cities and of urbanization are discussed in terms of highways, traffic problems, air pollution, water supply, parks and recreation areas, crime and police protection, fire education, libraries, noise, waste collection and disposal, taxes and public expenditures, the overlapping units of government, and planning. The book contains 15 chapters and a subject index.

**64-0120**
Harrogate. Public Cleansing, 54(1):669, Jan. 1964.

The annual report on refuse collection and disposal of Harrogate, England is reviewed. There is an increase in tonnage and volume, and the growth of building on the perimeter of the town is affecting the length of haul. Refuse is disposed of by controlled tipping which has resulted in reclaimed land.

**64-0121**
Haug, L. A., and S. Davidson. Refuse collection and disposal survey indicates changing trends in 118 Western cities. Western City, 40(4):26, 28, 30, 31, 34, Apr. 1964.

The current survey indicates that 27 percent of 118 cities include backyard collection as part of their basic service. Some cities collect rubbish from curb or alley and garbage from the rear year. Often, if there is a market, waste material is separated into: (1) clean paper, (2) glass, (3) metals, and (4) food wastes for hog feed. Most cities report refuse collection by cities most popular, followed by private arrangements and contract services. The size of packers is enlarging, as shown in Inglewood, California, which uses 38 cu yd capacity packers and in South Gate with 30 cu yd capacity packers. The packer design, a relatively new piece of equipment permits a one-man operation. The vast majority of cities set maximum container size or weight by ordinance with the largest number of cities setting the limit at 30 to 35 gal. (The article also contains an extensive chart on 'Collection and Disposal of Garbage and Refuse in 118 Western Cities'.)

**64-0122**
Hope, M. C. Keynote address. In Proceedings; Ad Hoc Conference on Solid Waste Training.

Robert A. Taft Sanitary Engineering Center, Cincinnati, Nov. 4-6, 1964. U.S. Public Health Service. p.1-6.

Storing, collecting, treating, and disposing of solid wastes from our communities, business establishments, industries, and farms pose problems of mounting complexity and urgency. Increasing concentrations of people in urban areas and improved living standards result in rising refuse/person production. Furthermore, present management methods are already largely inadequate for the problem at hand, and the public is not demonstrating the requisite concern that authorities need as a mandate for action. Solid waste management is, in large part, a major economic problem. Public and private costs total about $2.8 billion; 75 to 80 percent of this amount is spent for collection. Local officials, as in New York City, Boston, and Los Angeles are striving to solve the problem. Planning agencies--multi-jurisdictional, city-county, and county--have completed or are in the process of producing 31 research studies. State leadership is essential, yet only nine states have achieved major progress. In the Federal Government, the Public Health Service provides technical assistance, guidance and consultation, besides economic aid. It is cooperating with the Tennessee Valley Authority (composting) the various APWA (handling), and various universities (training). More research is required on the characteristics of solid wastes and new processes for transportation and ultimate disposal. Better communication must exist between researcher and practitioner. Important legislation has been introduced but not yet enacted. The magnitude of the dilemma calls for combined effort throughout the nation.

**64-0123**

Hughes, K. S. Dispose of wastes. Sanitation Series No. 6. U.S. Department of Agriculture, Federal Extension Service, June 1963. 10 p.

Waste disposal methods for rural areas are presented. Topics covered include: garbage, trash, human wastes, sanitary latrines, waste water, animal wastes, and dead animals. This booklet is designed as an aid to extension and village workers in many countries.

**64-0124**

Jacocks, F. A. Environmental sanitation surveys. U.S. Public Health Service, Oct. 1962. 12 p.

The need for planning is evident in many fields--assessing the present situation as well as the accumulation of data so that guides can be established for future activities. With this in mind the Public Health Service has prepared an Environmental Health Planning Guide which deals with the following subjects: health agency operations, planning agency, air pollution control, housing programs, radiological health, refuse collection and disposal, sanitation programs, sewerage services, and water supply services. The Guide serves its most useful purpose in areas where there is no organized planning group. Field surveys at Omaha, Nebraska; Lake county, Illinois; and Fort Wayne, Indiana; are disucssed. Corrective actions after these surveys are presented. The Public Health Service believes that it can best fulfill its obligation in the field of environmental health planning by use of two week resident courses, given approximately twice a year, short (usually two days) orientation courses, and by assistance in field demonstrations courses. Places where these courses are held are given.

**64-0125**

Kampschulte, J. Urban sanitation. VDI (Verin Deutscher Ingenieure) Zeitschrift, 106(14):599-603, May 1964.

International problems of waste disposal and modern ways and means of coping with them were discussed at two technical meetings. The meetings were accompanied by an exhibition of the newest models of street cleaning machines and waste removal trucks, including new sweeping machines (one with a loading capacity of two tons), a number of snow plows, snow blowers, and sand strewing vehicles, some with salt blower attachments. The newest concept in the field of waste disposal is a recommendation to state the amounts of waste by weight, the annual amounts of waste by ton per year. Currently, plastic waste containers are being tried out in various cities in West Germany. Paper bags have been introduced in places (e.g. hospitals) where it can be guaranteed that no glowing ashes will be deposited. Large refuse containers have come into more extensive use, mainly because they can be removed and replaced by vehicles operated by one man. Almost all waste removal trucks are now equipped with facilities for compacting the waste to one-third of its volume. Bulky refuse is handled by special vehicles with large conical drums which can crush even large objects, such as pieces of furniture. (Text-German)

**64-0126**

Kaupert W. INTAPUC conference in Vienna, Austria. Staedtehygiene, 15(8):187-189, Aug. 1964.

An international meeting on waste disposal problems was held in Vienna, Austria. The first papers discussed personnel problems and the work output of street cleaners. It was pointed out that the work output of a street cleaner fluctuates between 45 percent and 28 percent of the standard output, depending on the width of sidewalks, obstacles, steps, rain, wind, and working technique. It was reported from Zurich that a mobile hammermill equipped with a VW motor analyzes the accumulating waste for qualification as composting or incineration. It was suggested that a uniform method of analysis be used internationally. It was also suggested that in addition to composting plants, incinerators are justified in smaller cities. The design of the new waste incinerator in Vienna, which consists of three furnaces with a capacity of 200 ton per day each, was discussed. It is expected that the proceeds from the sale of heat, which is supplied to hospitals, will cover not only the operating costs but also the costs for amortization. In conclusion, a report on street cleaning vehicles was given in which a multi-purpose vehicle for sweeping, washing and snow plowing was favored. (Text-German)

**64-0127**

Klock, J. W. The sanitary scientist of 1970. Public Health Reports, 79(1):71-72, Jan. 1964.

The sanitary scientist must devise and apply acceptable standards for air, water, waste disposal, food, and shelter besides discovering means to reconstitute the wastes produced into usable commodities. Only when these two tasks have been successfully undertaken, can man fully utilize the resources of his environment. To deal effectively with the complex cyclic phenomena of nature--biological, meteorological, and geological-- the scientist of today must understand all facets of water, sewage, air, solid wastes, radiological, food sanitation, epidemiological, and industrial hygiene problems. Certain fundamental skills in basic areas are requisite, with a strong chemical, biological, and engineering backgrounds preferred. Especially important areas of study include physical chemistry, biochemistry, the earth sciences, biological, and social sciences. Thorough preparation in mathematics and statistics for interrelation and quantitative interpretation of these sciences is also essential. Once adequately trained, the scientist can then favorably coordinate the biological, geological, and meteorological cycles of nature with health and sanitation concepts.

**64-0128**

Kuehn, O. Equipment development. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.85-90.

The development of changes and advancements in refuse disposal trucks over the past ten years, has been very limited. The most revolutionary change has been the ejector plate for removing the refuse from these units, rather than dump type removal. A study should be made of which size unit is the more economical from the standpoint of compaction. At the present time, a 10 or 12 yd body will hold far more refuse by weight per cu yd than proportionately can be put into a 20 or 25 yd unit. The items to which research efforts could be applied are: study of equipment use-segregating refuse-weight-equipment, cost-man power-ejector plate, or dump body-aluminum bodies and frames-plastic material-all related to refuse truck use; and engine study-size-HP-torque and formulas to justify agreed on size of engine, etc.-twin disc clutches-double reduction rear axles-lubrication-motor oils, etc. -transistorized ignition-realistic preventative maintenance program-wide tread aeroplane tires. In new incinerators where two or more cranes are used for bringing the refuse from the pit up to the charging hopper, a centralized control room is being advocated. The advantages of this type of installation are enumerated.

**64-0129**

Kumpf, E., and K. Maas. Refuse and waste removal. International Research Group on Refuse Disposal (IRGRD) Information Bulletin No. 20. Washington, U.S. Department of Health, Education, and Welfare, May 1964. p.59-60.

This work presents a comprehensive representation and explanation on the entire subject of collection, removal, and utilization of refuse from households, communities, industry, and trade. Extensive collaboration with local and foreign specialists ensures complete and fundamental explanation, including special problems. It covers all those problems of technical, organizational, and economical kind, which always occur in practice. Extensive information is also given about legal requirements. This handbook will probably be extended to four parts and later supplemented from time to time following technical developments. The first issue of 276 pages is now available and is highly recommended.

**64-0130**
Labor relations in public cleansing. Public Cleansing, 54(6):933-936, June 1964.

Two papers on labor relations presented by the president of the Institute of Public Cleansing of Britain and by the director of Public Cleansing of Stockholm, Sweden are reported. The first noted higher living standards for the workmen as manifested by greater pay and improved working conditions and recommended joint consultation between management and representatives of the workmen. The second paper recommended the employment of the incentive bonus system of piece-rates of work to improve work quality and also discussed transfer stations and incineration in Stockholm.

**64-0131**
Leyland U. D. C. Public Cleansing, 54(1):671, Jan. 1964.

The annual report on refuse collection and disposal of Leyland, England is summarized. An increase in weight and volume of refuse, partly due to town growth, and a rise in costs is noted. The municipal dustbin scheme and salvaging have been executed satisfactorily.

**64-0132**
McKee, J. E. Dimensions of the solid waste problem. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.1-7.

It is conventional to divide the solid-waste problem into two major areas: collection, including storage, transfer, and transport; and disposal, including any concomitant treatment. For refuse, it is estimated that 80 to 90 percent of the total cost is attributable to collection and transportation, with only 10 to 20 percent arising from disposal by landfill operations. If incineration is employed, approximately 60 percent of the total cost arises from collection and 40 percent from incineration. In Los Angeles County, the solid-waste problem is over four times as large as the liquid-waste problem on a dry-weight basis, slightly larger in total annual cost, and over three times as large on the basis of annual operating cost. It is expected that comparative figures for other metropolitan areas will be of a similar magnitude. Total expenditures for research in the area of liquid wastes are of the general magnitude of $10 million per year. In contrast, the total research expenditures for refuse collection and disposal probably do not exceed $200,000 per year. In the absence of adequate collection aenforced rules against burning, much of the trash of a community may be converted into gaseous pollutants by inefficient combustion. Sanitary landfill has been shown to be an effective and economic method of refuse disposal in most areas. But land suitable for landfill is fast disappearing in many metropolitan areas. There is no sizable market for compost from solid wastes and none is likely to develop in the near future.

**64-0133**
Miller, M. The treatment of refuse in the Soviet Union. Compost Science, 5(2):17-19, Summer 1964.

A detailed account of refuse collection in Moscow is presented. For organizational purposes a district administration and a communal administration was established. The district administration removes refuse daily. The driver's wages are graded and a bonus incentive system is employed. The communal administration is responsible for the supply and upkeep of the refuse containers. Food residue collection, which is carried out by the tenants of the buildings, is handled separately and goes directly to pig food factories. In 1962, a refuse utilization plant with a capacity of 400,000 cu m per year was put into operation. Refuse collection in Moscow at this time was 1 million cu m per year. Before the plant was designed, the composition of refuse was investigated, and the results are tabulated. One kg of residues gives 1,400 cal of heat, thus giving a total of 15 million kg cal, which is sufficient to cover all the technological processes in the plant. The design and reception unit of the plant is described in detail. The refuse is carefully sorted and 15 percent of it is composted. Cost of construction of the plant has been estimated at 1.24 million rubles. The factory is self-supporting, since the receipts from the sale of the recovered scrap and the 15 percent compost cover the costs.

**64-0134**
Morristown Chamber of Commerce. Refuse collection and disposal. In Morristown. Morristown, Tenn., Feb. 1963. p.18-19.

It is estimated that each person generates one half ton of refuse per year in Morristown. Because the characteristics of refuse vary widely, several methods of disposal are used. The selection is usually based on what is locally acceptable and will cause the least detriment to its environment. City collection is available within the city with residential collection once a week and commerical establishments once a day. Within the county, the county provides for the collection of garbage once a week to approximately 2,500 homes with the remainder of the county receiving a collection once each two weeks. All solid waste that is collected within the city and county is fill and cover for the garbage and the burning of brush, sawdust, and wood scraps. This burning operation contributes to the air pollution problem and should be discontinued. There are no regulations governing garbage containers within the county. Action is definitely needed as the collection only once each two weeks creates a health hazard. The city has a vector control and a continuous rodent control program.

**64-0135**
Pacific Southwest Inter-Agency Committee. Columbia Basin Inter-Agency Committee. Suggested design criteria for refuse storage collection and disposal in recreational areas. Washington, U.S. Public Health Service, 1963. 20 p.

Many of the refuse and solid waste disposal problems in recreational areas may be unique to the extent of requiring special studies and engineering judgment in the selection and design of suitable facilities. Material is presented to provide guidelines for establishing effective sanitary refuse disposal, practices, to describe various methods of refuse disposal, and to suggest procedures meeting public health requirements with a view to promoting uniformity of practice. The procedures presented are not proposed as firm standards or as regulations. Preparation of refuse, storage containers, and container racks is described. Collection trucks suitable for use in recreational areas are considered. Disposal by sanitary landfill is recommended where possible and incineration is suggested as the next best method. Emphasis is placed on special procedures to prevent rodents and wild animals from interfering with the handling of solid wastes in parks, campgrounds, and picnic areas.

**64-0136**
Pacific Southwest Inter-Agency Committee. Columbia Basin Inter-Agency Committee. Storage of refuse. In Suggested design criteria for refuse storage collection and disposal in recreational areas. Washington, U.S. Public Health Service, 1963. p.4-6

Draining and wrapping of garbage prevents corrosion of cans and odors. The collection of garbage from recreational areas for hog feeding should be discouraged. Bundles of bulky wastes should not weight more than about 50 lb, and their length should not exceed 4 ft. All garbage should be kept in durable, watertight, rust resistant, non-absorbent, and easily washable containers that are covered with closefitting lids and furnished with suitable handles. Lining the container with paper or providing a disposable plastic liner will aid in maintaining cleanliness. The conventional heavy-duty galvanized iron garbage can with recessed bottom of 20 to 30 gal capacity meets all requirements. Special attention should be given to the construction and location of containers in campgrounds and picnic and cabin areas where animals are encountered. The containers should be effectively anchored. All garbage containers at food service establishments should be kept on concrete slabs or elevated metal stands. All storage racks should have open bottoms and should hold containers at least 12 in. off the ground. Concrete slabs are generally not as satisfactory as racks. When any liquid or solid residue remains, it should be washed from the can and flushed into the sewage system. In campgrounds and picnic areas, cans are generally located near roads for convenience.

**64-0137**
Pacific Southwest Inter-Agency Committee. Columbia Basin Inter-Agency Committee. Collection of refuse. In Suggested design

criteria for refuse storage collection and disposal in recreational areas. Washington, U.S. Public Health Service, 1963. p.7-9

Frequent, systematic, and reliable collection service should be the goal of every development. The frequency of collection will vary according to the type of facility being served, but, in general the following periods should prevail: daily for large food service establishments; twice weekly for residential areas; and daily to once or twice weekly for picnic areas, campgrounds, and parking areas. Collection of refuse in recreational areas may be provided by contract, by the concessionaire operating the area, or by the agency responsible for the administration of the area. Combined collection prevents some abuses and conditions that are conducive to high pest and vector populations. Most state laws require that garbage be adequately heat-treated to kill animal disease organisms before being fed to hogs. Modern, enclosed, liquid-tight truck bodies prevent scattering of loose material, leakage of liquids, and minimize odor production. Compactor trucks are practical for large areas because they have an increased load capacity. Open trucks may be used for three limbs, trimmings, and noncompressible items, including ashes. The following types of collection trucks are considered satisfactory for recreational areas: trucks with dump or fixed-type, watertight bodies; can-exchange trucks; and enclosed trucks equipped with power elevators and/or mechanical compactors.

**64-0138**

Pacific Southwest Inter-Agency Committee. Columbia Basin Inter-Agency Committee. Disposal of refuse. In Suggested design criteria for refuse storage collection and disposal in recreational areas. Washington, U.S. Public Health Service, 1963. p.10-19.

Sanitary landfills are widely used where suitable unwooded land is conveniently located because both initial and operating costs are generally low. Equipment, personnel, and operating procedures for the trench method, ramp or progressive slope method, and area method are described. Valleys and ravines may be used as landfill sites if operations do not interfere with natural drainage. Well designed and efficiently operated incinerators eliminate food for bears and rats and breeding places for flies. Since incineration has proved to be an effective means of refuse disposal in recreational areas, this method is the best alternative where landfilling is not practical. Multiple-chamber incinerators are described because they can be expected to burn refuse with a minimum discharge of air contaminants. The incinerator should be located in an inconspicuous spot as near as possible to the center of the area to be served. The site should be accessible by road, preferably those that are not used by the public. Where bears are prevalent, the incinerator should be charged as soon as possible and the area fenced to minimize attraction. Incinerator size can be determined from the amount of refuse to be burned on a lb per day basis. Basic refuse quantities are listed for lodges and hotels, campgrounds, picnic areas, and park headquarters. Garbage grinding and hog feeding may also be practiced.

**64-0139**

Personnel management in cleansing service. Public Cleansing, 54(10):1223, Oct. 1964.

At the meeting of the Junior Members' Discussion Group of the Institute of Public Cleansing's Scottish Centre, the personnel officer of the Cleansing Department of Edinburgh presented a paper 'Personnel Management in the Cleansing Service.' The history, definition and scope of personnel management in the cleansing service, the needs of recruitment, communications and relations with staffs, and training are discussed.

**64-0140**

'Piggy back' trailers key to Detroit plant. Refuse Removal Journal, 7(7):28, July 1964.

Detroit is considering a program of waste disposal which includes rail transfer stations, giant 64 cu yd compaction trailers that would ride 'piggy back' on special flat cars to distant unloading points, and a ring of sanitary landfill sites located well beyond the economical hauling ranges possible under present conditions.

**64-0141**

Preston prepares for long term refuse disposal. Surveyor and Municipal Engineer, 123(3743):54, Feb. 29, 1964.

The nine months experience with the new method of disposing of an annual load of

34,000 tons of local refuse is described. The plan involves controlled dumping 7 miles from Preston in Lancashire in an area which should be adequate for 110 years. A transfer loading station was provided so that the house-to-house collection vehicles could discharge their contents to be picked up by large trucks with the capacity to move the refuse in bulk to the dump. The transfer station and the surrounding areas are kept clean by highly efficient dust collectors.

**64-0142**
Proceedings; Ad Hoc Conference on Solid Waste Training. Robert A. Taft Sanitary Engineering Center, Cincinnati, Nov. 4-6, 1964.
U.S. Public Health Service. 71 p.

The conference pointed out weak areas in solid wastes services and facilities and made recommendations for improvement. Problems exist with litter, special wastes, lack of communication, and unpassed legislation The agenda included discussion on storage, collection, disposal, planning, implementation of a program, the role of education and training courses. The Public Health Service bears the major burden for building a training program for all levels of responsibilities. The roles of State and local agencies and universities are discussed.

**64-0143**
Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963.
American Public Works Association, 1964.
228 p.

The major objectives for this conference as set forth by the planning committee were: to stimulate research on problems in the field; to stimulate young researchers to work in the field; to point out resources for support of research in the field; to delineate the solid waste problems by operational people; and to project future needs in order to plan for long-range problems. The 2½ day meeting provided an opportunity for each group to communicate their view to the other groups. The proceedings represent the latest ideas on the research needs in this area, as seen by the conference participants. Various papers are presented from each of the groups: quantities and characteristics of solid wastes; waste collection, storage, and transportation; treatment and disposal of solid wastes; and processing, conversion, and utilization of solid wastes. A lengthy discussion session follows each paper. Summary reports were offered at the final session of the conference. The conference was sponsored by the Environmental Sciences and Engineering Study Section of the U.S. Public Health Service in cooperation with the American Public Works Association held at the University of Chicago, Center for Continuing Education. The conference was supported by a Public Health Service Grant.

**64-0144**
Public Works operations in Milwaukee. Public Works, S95(9):84, Sept. 1964.

The services of the Milwaukee Bureau of Public Works are described. These include garbage collection, incineration of refuse, traffic sign installation, sewer maintenance, and snow and ice control. Over 123,000 tons of refuse were collected in 1963, at a total expenditure of $3,338,000. Combustible refuse burned amounted to 126,377 tons in 1963. The estimated snowfall in 1963 was 34 in. This required 24 ice control and salting operations and three plowing operations, which cost the city an estimated $800,000.

**64-0145**
Purdue University. A report on the sampling and composition of municipal refuse. Lafayette, Ind., 1962.

On March 6, 1961, a one-year refuse survey was initiated between the City of Bloomington and Purdue University. The purpose of the survey was to supply Purdue with basic data to statistically evaluate a proposed sampling method for determining the composition of municipal refuse, and to make available the basic data for use by the City to determine future methods of refuse collection and disposal. A total of eight sampling areas was chosen for the study. The sample areas consisted of a total of 582 people and 182 housing units. The total quantity of refuse contributed by the sample areas was collected by a special crew and brought to a central location for further processing. Each area's refuse was separated into three categories: paper, wood, leaves, etc.; garbage; and non-combustibles. At eight different times throughout the year the total quantity of refuse produced by the City of Bloomington was weighed at a local weighing station. This provided a check for the calculated sample weights. The total quantity of material, weight and volume, for the entire city varied from a low in March to a high in October and July. The bulk density was, in general, higher during the fall and winter than during the spring and summer. Perhaps the most significant result of the data obtained was the relatively low percent of combustibles and garbage in the refuse as compared to values obtained by surveys in other cities. The percentage of non-combustibles was high. The high percent of ash content results in an unusually low Btu value for the total refuse.

**64-0146**
Quake victims engaged in gigantic clean-up job. Refuse Removal Journal, 7(5):8, May 1964.

Anchorage's private refuse haulers and the Department of Sanitation are laboring hard to clean up the tons of rubbish caused by the earthquake of March 27. One hundred downtown buildings and 50 percent of the other large structures will probably have to be torn down. Since all the rubbish probably can't fit in the city's one sanitary landfill, it might be buried in the gullies and craters wrought by the quake. The city's sanitation operations under normal circumstances are also described.

**64-0147**
Refuse collection and disposal. In Environmental health survey Wayne Township, New Jersey. Cincinnati, U.S. Public Health Service, July 1964. p.23-30.

Wayne Township has 9,400 dwellings and 625 commercial and industrial establishments. The collection of refuse with few exceptions is by private scavengers. A 1963 survey indicated that 97.5 percent of homes have collection service. The remaining dispose of their refuse by on-site burial. Scavengers are licensed by the Health Department and uniform fees of $1.75 per month for two collections per week with curb service or $3 per month for collection at the door are charged by all scavengers. Collection charges for commercial establishments vary from $5 to $300 per month. Disposal of refuse is by sanitary landfill on meadow lands in North Arlington and Rutherford. There is a privately owned dumping area used for demolition waste and household refuse exclusive of garbage which is in good condition. Maintenance of a small town dump, about 2 acres in extent, is unsatisfactory. It is recommended that a master refuse plan be prepared for Wayne to include cooperation with other communities, Federal and State agencies, and universities. It was also suggested that the private dump be cleaned up and that dumping at the town dump be terminated.

**64-0148**
Refuse collection and disposal. In Training course environmental health survey, report and recommendations, Greater San Buenaventura, California. U.S. Public Health Service, Mar. 1964. p.39-42.

Separate collection of garbage is required in San Buenaventura, California. It is available at no extra cost. There are no requirements regarding refuse collection. The garbage collector has a contract with the city and hauls and disposes of refuse at a nearby hog farm. The need for these two different services is questionable. The city ordinance on collection vehicles is extremely lax, but the streets appear exceptionally clean and litter-free. The urban fringe is serviced by private transaction with individual refuse collecting agencies. Permits for refuse collectors are obtained at the sheriff's office, but he imposes no regulations upon the operation. County and private sanitary landfills are the method of refuse disposal. The private landfill is used by most city collectors due to the lower charges there. Approved individual incinerators are allowed to operate from 7 am until 12 noon. The restrictions are lax in this area, also. Recommendations by the group of health officials include: a feasibility study of a municipal or franchise refuse collection operation; a county-wide master plan for disposal to meet expanded needs; the need to reduce fly breeding; the setting of higher standards for private collectors; the installation of garbage grinders; and the elimination of backyard incineration.

**64-0149**
Refuse. In Environmental health report/Macon, Georgia. Macon, Apr. 1964. p.8-12.

There is a need for more rigid control and enforcement of the collection ordinance of Macon-Bibb County. Through the efforts of only one man in the enforcement section of the Public Works Department, approximately 100 violators have been convicted during the year. Macon, through the Department of Public Works, provides refuse collection service to 100 percent of the city residences twice weekly. The residential area is divided into 46 collection routes of 850 units of pickup. The growth trend during the past 2 years indicates a yearly increase of 800 units. Industries within the city dispose of their own solid wastes. The City of Macon owns and operates two areas for dumping solid wastes. Combustible and non-combustible wastes, excluding garbage and putrescible matter, are deposited on an open dump. Residential refuse and putrescible waste from commercial establishments and industries are incorporated in a sanitary landfill. The open dump, while being sheltered from the view of the public, presents an unsightly appearance. No covering operation is carried on at this dump. The sanitary landfill has encountered problems during wet seasons. The lack of funds, personnel and cooperation of other agencies defeat any organized control of the sites. A list of recommendations for the future is furnished. The study is co-sponsored by The Georgia Department of Public Health in cooperation with The University of Georgia and the U.S. Public Health Service.

**64-0150**
Refuse. In Environmental health report of Augusta, Georgia. Richmond County Department of Health, Aug. 1964. Section 111.

It is estimated that over 91,000 tons of refuse are produced annually in all of Richmond County and by 1985 this amount will increase to about 177,000 tons. Consideration was given to refuse collection and disposal in the City of Augusta as well as the entire county of Richmond. The City of Augusta provides regular refuse collection and disposal service to all residents, business establishments, and industrial firms within the city limits. No fees are charged for this service. Garbage collection is daily. Disposal of Augusta refuse is by one modified sanitary landfill. Broad criteria for a successful facility of this type includes freedom from odor nuisance, fly breeding, rodent harborage, and smoke problems. The Augusta landfill fails to meet any of these standards. Refuse is covered but not adequately. A heavy fly population was noted at the time the fill was surveyed, and trash as well as garbage was burning and smoking heavily. The city's budget provides for $380,000 for collection and disposal. Refuse disposal at the Fort Gordon Military Reservation is accomplished by means of an efficiently operated standard sanitary landfill within the reservation area. A list of recommendations for future action is furnished. The survey is co-sponsored by the Augusta Chamber of Commerce, Augusta-Richmond County Planning Commission, Georgia Department of Public Health in cooperation with The University of Georgia, Georgia Department of Industry and Trade, and U.S. Public Health Service.

**64-0151**
Savage, E. P., M. D. Bogue, and W. G. Brown. A study of rodent control problems in Boston, Massachusetts, 1963. Atlanta, U.S. Public Health Service Communicable Disease Center, Feb. 1963. 49 p.

On June 6, 1962, the Boston City Health Department requested the Public Health Service and the Massachusetts State Department of Health to determine the magnitude, nature, and causes of rodent infestations in Boston, and to recommend procedures whereby the city could reduce the rodent problem. The study that resulted covered: exterior surveys of 3,647 premises located in 150 city blocks; inside inspection of 1,784 buildings, including 46 food establishments; and an analysis of the Back Bay rodent control program. All the evidence collected on the surveys in Boston indicates a high degree of container-damage by refuse collectors so that the containers could not be covered. Rats were noticed in food establishments and in parks and parkways, but were minimal in waterfront areas, granaries, and warehouses. There is evidence that drainageways may serve as a hub for rodent infestations in adjacent areas. Recommendations were made to the Boston City Health Department in the areas of: personnel; food establishments; and the storage, preparation, collection and disposal of solid wastes. It was recommended that the Department employ a full-time qualified rodent control supervisor to direct and coordinate all rodent control activities within the city. Results of all studies made in the Boston area revealed that the potential for rodent infestation is city-wide, but that rodent problems are greatest in Dorchester, Back Bay, Roxbury, Charlestown, and Allston-Brighton.

**64-0152**
Solid waste handling in metropolitan areas. Public Health Service Publication No. 1554.

Washington, U.S. Government Printing Office, 1964. 41 p.

This Public Health Service publication was prepared for the Surgeon General's Advisory Committee on Urban Health Affairs by the National Center for Urban and Industrial Health, Bureau of Disease Prevention and Environmental Control. The table of contents lists the following: The Problem; Public Health Implications: Economic Impact; Legal Aspects; Effect of Community Differences and Technological Advances; Lack of Public Concern; Development of Standards; Research and Training; The Metropolitan-wide Approach; State and Local Action; Role of the Public Health Service; Policy Questions; and a 43 citation bibliography.

**64-0153**

Statistics on the removal of solid waste. Wasser und Abwasser, 105(24):670-671, June 12, 1964.

In the series 'Reports from Stuttgart on residential water economy' there appeared an 'evaluation of the statistics on solid waste disposal in the year 1961', edited by Michael Ferber of the Technical University of Stuttgart. The data published in this booklet are of great importance for the evaluation of the problem of waste disposal. The statistics comprise 583 municipalities having a population of more than 10,000 and a total population of 32.2 millions which is about 55 percent of West Germany's entire population. 533 municipalities with a total population of 31.4 millions have made participation at a waste collection service compulsory. The average amount of waste by weight was 249 kg per resident per year, by volume, 734 liters per resident per year. The specific weight was 340 per kg cu m. On the average one truck was available for removing the waste of 10,200 residents; 389 municipalities had weekly waste collecting schedules; 53 collected waste once or twice and 134 twice a week. The 533 municipalities reported a total amount of approximately 8 million tons of waste for the year 1961 of which 97 percent were dumped, 2.2 percent burned, and 0.82 percent composted. The statistics further pointed out that 147 municipalities have disposal sites for only 2 to 6 years, 71 for 6 to 10 years, and 77 for more than 10 years. (Text-German)

**64-0154**

Stead, F. M. Ecological considerations, administration of solid waste collection and disposal systems and research implications. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.12-15.

Environmental sanitation programs in the United States are based on three assumptions: unwanted waste products are best handled by discharge into the environment; having done this, man can be adequately protected at the point of exposure or at the point of consumption; and the needed action can be taken to protect the public health with virtually the unlimited use of the police powers, no other considerations intervening, to avoid a disastrous effect. Today 90 percent of the people in California live in an area where the transparency of the air has been drastically reduced. Eighty percent of the people live in areas where there is a marked detrimental effect on vegetation and agricultural crops of one sort or another. Seventy percent live in an area where during many days of the year there is severe physiological discomfort. Looking to the future there are only two choices. The present rear guard action can be continued with the certainty of final defeat, or a new concept can be adopted--one with a prospect of permanent success. The geographical denominator is set by the topography, not by the political boundary. In the case of solid waste, some thought must be given to converting useless organic materials to a resource of value. Organic wastes must be thought of as a savings account--a working supply of basic materials, not only for the production of fabrics, structural materials, and chemicals, but also as a source of carbon, hydrogen, oxygen, sulphur, and other materials which can be reprocessed.

**64-0155**

Stead, F. M. Solid waste collection and disposal systems--ecology, administration, research. Compost Science, 5(1):5-6, Spring 1964.

Due to the current rapid rate of change, the present concepts of environmental sanitation programs will soon be obsolete. Sanitation programs are based on three assumptions. First, unwanted waste products are best handled by discharge into the environment. Second, man can be protected at the point of exposure. Last, we can take any degree of action requisite to protect public health. With respect to water resources, the State of California is greatly concerned by increasing mineralization. The principal source of this mineral burden is agriculture. Chemical usage has increased the mineral content of irrigation return flows until now they endanger water supply systems. Two choices exist. Present action can be continued with only bleak prospects or new concepts can be adopted. An example of the latter is the development of an environmental health program--a total system to handle air, water, and land resources. This can be accomplished either on a state or regional basis, for the common denominator is topography. Solid wastes must be converted to usable materials to produce fabrics, structural materials and chemicals, and to form substances that can form living materials. By composting and placing compost in a compact fill and consolidating all organic wastes, this task can be achieved. The water carriage principle for transporting wastes must be replaced by utilizing wastes at processing sites. Finally, the public interest must be completely identified and decision-making machinery put into operation for ultimate success.

**64-0156**

Steady progress in cleansing in Mombasa. Public Cleansing, 54(1):672, Jan. 1964.

Refuse collection and disposal on the tropical island of Mombasa is reviewed. A reduction of 789 days in absence from sickness and a low labor turnover are noted. Trailers transport the refuse to controlled tipping areas. The regulation requiring the use of dustbins causes problems because it is not being enforced.

**64-0157**

Sumner, J. Technical developments in refuse collection and disposal. Public Cleansing, 54(4):822, Apr. 1964.

Modern technical developments in refuse collection and disposal in Great Britain are surveyed. Trends in the character of refuse--such as an increase in weight and volume and a decrease in density--and their effect on refuse handling are analyzed. Developments are discussed: (1) refuse storage, including lighter containers, chutes systems, turntable carrying 4 to 6 containers at the receiving end of a chute system. Garchey system, kitchen grinders, and containerization; (2) collection vehicles, including different kinds of compression equipment and material used to construct vehicle bodies; (3) refuse disposal, including sanitary landfilling, pulverization, incineration and composting; (4) methods of refuse collection, including the dustless loading system and the paper sack system; (5) transfer loading stations, which vary from the relatively simple to the more mechanized type; and (6) methods to avoid polluting ground water.

**64-0158**

Sundquist, S. Labour relations in public cleansing. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 30 p.

In Swedish labor relations an increased productivity is one of the basic prerequisites for the achievement of a higher standard of living. The endeavors of employers and workers are manifested in the agreements between various employers' associations and the respective trade unions, for example, regulations for the application of piece-work contracts. Public Cleansing in Sweden is chiefly conducted by municipalities and in Stockholm the municipal cleansing department is responsible for street-sweeping, and refuse collection and destruction. Some conventional methods of work in public cleansing in Stockholm are discussed. Manual street-sweeping is done on a piece-contract, and streets are classified as to working effort required. The results of time and motion studies of manual sweeping are given. The principal sweeping of dust from roadways and gutters is done by sweeper-collector machines paid on piece-contract. Every machine has an instrument recording its operation. In Stockholm the flushing of roadways with water is used to complement machine sweeping and these operations are reviewed. Gullies are cleaned by machine with an average of 2.5 cleanings per gully per year. The landlord is responsible for the collection and disposal of refuse in dumping grounds indicated by the municipality. An account of the piece-work times is provided. The activities of the one incinerator plant at Loevsta and the transfer stations are described. The Department of Public Cleansing in Stockholm is responsible for snow clearing and sanding. Eight percent of the total volume work load is rated for piece-work. This has the advantage of establishing high quality standards.

**64-0159**
Tauber, F. The industry at the INTAPUC exposition. Staedtehygiene, 15(10):236-239, Oct. 1964.

Many companies from all over Europe participated at the exposition in Vienna, Austria. A multi-stage traveling grate furnace and a rotating tube furnace were on display. A special feature of the incinerator by Maslit Export AB, Sundbyberg, is the furnace which is inclined so that the waste glides down to the grate by gravity. In the section on street cleaning machines, an automatic sweeper which operates pneumatically through a circulating air current was shown. Waste containers with a volume of 3.7 cu m were exhibited together with the vehicle for transporting these containers. Three of these containers can be transported at a time and they can be emptied conveniently through tilting devices. Various types of waste removal trucks and sweeping machines were also on display. (Text-German)

**64-0160**
Training course environmental health survey, report and recommendations, Greater San Buenaventura, California. U.S. Public Health Service, Mar. 1964. 78 p.

This publication is a report of an environmental health survey of the city of San Buenaventura, California, and adjacent areas of Ventura County. It was conducted as a training exercise during presentation of the course, Urban Planning for Environmental Health, February 24 to 29, 1964. It contains recommendations for a proposal, approach, and follow-up for an environmental health plan. This was drawn up by a team composed of Public Health Service and State Health officials. Group reports are contained on the subjects of water services, sewerage services, refuse collection and disposal, vector control, air pollution control, housing programs, environmental health programs, and planning. Illustrations, charts, and additional data are contained as supplements to the group reports.

**64-0161**
Turkey's capitol modernizes entire sanitation system. Refuse Removal Journal, 7(8):25, Aug. 1964.

The old method of trash collection and disposal in Istanbul, Turkey is compared with a newly introduced modern method modeled after those of the American city. The modern method will retain horse-drawn carts to negotiate the narrow and crooked streets of the city's ancient section. Otherwise, there will be a complete modernization of the sanitation system.

**64-0162**
U.S. Public Health Service. Environmental health survey Greater Lexington area. Cincinnati, Apr. 1963. 85 p.

At the mutual request of the Lexington-Fayette County Department and the Kentucky State Department of Health, the U.S. Public Health Service conducted the training course, Urban Planning for Environmental Health, Apr. 1 to 12, 1963, in Lexington, Kentucky. Through the use of personal observations and interviews with people in both official and nonofficial capacity throughout the area, information was obtained during a two day period regarding local environmental health conditions. The group reports cover general health services; planning; water supply services; sewerage services; solid waste storage; collection and disposal; housing, air pollution control and radiological health. Recommendations were summarized and a class roster appended.

**64-0163**
U.S. Public Health Service. Sewerage services. In Environmental health survey Greater Lexington area. Cincinnati, Apr. 1963. p.49-55.

A newly completed sewage treatment plant, costing approximately $3 million, provides primary and secondary treatment (90 to 95 percent BOD reduction) for 8 mgd (million gallons per day) with a capacity of 12 mgd and capabilities of expanding to 27 mgd. It uses the activated sludge type process and has Town Branch as its dilution stream. Approximately 26 percent, or 9,000 homes in the Lexington area, use septic tanks as a method of sewage disposal. Sewer problems originate not because of poor facilities or lack of sewers but because some of the urban area people are unwilling to give up septic tanks due to the expense. Industrial wastes are presently governed by a city ordinance requiring pre-treatment to bring it down to an unobjectionable level. It is recommended that the standards, specifications, and policy for sewerage system and sewage treatment plant approvals be improved so that municipalities may be assured that small interim systems that will be absorbed later into a municipal system will meet the requirements of the major system. The establishment of an up-to-date comprehensive drainage plan for the present and future urban areas was also suggested.

**64-0164**
U.S. Public Health Service. Solid waste storage, collection and disposal. In Environmental health survey Greater Lexington area. Cincinnati, Apr. 1963. p.56-61.

A field review of residential storage provided evidence of a high degree of compliance with local ordinances, rules and regulations, which require metal containers of 30-gal capacity or less, with tight fitting covers. In commercial areas, rubbish was often placed for collection without the provisions necessary to prevent scattering and open burning was occasionally practiced. In both the city and the county there is twice a week collection of garbage and household wastes and once a week collection of rubbish. In the city, bulky items or large accumulations of rubbish are also collected upon request. Garbage and household wastes are collected from the backyard using the tub-out method, and rubbish collections are made from the curb. In 1962 this service required the use of 21 packer trucks, 10 open-bed trucks, and 108 men at a cost of $433,151. This averages $1.78 per residence per mo. A 200-ton per day incinerator is operated by the city on a 5-day wk, 16 hr per day schedule. During 1962, the incinerator burned an average of 140 tons per day of refuse with an operating cost of $2.36 per ton. The city also operates a dump for the disposal of rubbish, incinerator ash, construction and demolition wastes, and non-putrescible industrial wastes. The county government has not provided adequate disposal facilities. It is recommended that all open burning and dumping of refuse be discontinued and the sites improved to abate any nuisance.

**64-0165**
U.S. Public Health Service. Solid wastes. In Environmental health study 1963-Seattle and King County. 1963. p.28-29.

Several methods are used in King County for solid wastes collection. All of the county's 31 municipalities use some type of regulated collection system. The other municipalities are served by private collectors. A compulsory collection system with monthly charges is used in 16 municipalities. In 15 municipalities, and in the unincorporated areas, private refuse collection service is not mandatory. Residents who elect to use the services of one of the private collection companies pay them a monthly charge. The survey disclosed that 24 of the 31 communities wery not providing garbage or mixed refuse collection often enough during warm weather to prevent excess fly production. Sixteen communities were not using enclosed type collection trucks. Of the 21 refuse disposal sites in the county, only 10 are sanitary landfills operated by municipalities and the county. The other sites are trash dumps, open pit dumps, burning dumps, landfills covered infrequently, or a combination of unsatisfactory methods of waste disposal. There are three transfer stations to reduce hauling costs. By 1970, when the population of King County is expected to reach 1,175,000, the county will have to dispose of almost one million tons of waste per year. A list of recommendations is listed for the County. This study was made by the U.S. Public Health Service.

**64-0166**
What will be on show at Margate. Public Cleansing, 54(5):874, May 1964.

The equipment to be displayed at the 1964 British Institute of Public Cleansing Conference at Margate is described. Snow equipment, pedestrian and driver controlled mechanical sweepers, gully emptiers, refuse control tractors for use on controlled tip sites, protective clothing, paper sack systems, and various packer vehicles are discussed. The new types of machines and their new features are reviewed.

**64-0167**
What's on at the pictures. Public Cleansing, 54(9):1155, Sept. 1964.

Eight films on refuse collection and disposal available from the film library of the Institute of Public Cleansing are listed.

# COLLECTION AND TRANSPORATION OF REFUSE

**64-0168**

All waste is not the same--but it must be removed. Staedtehygiene, 15(10):242-243, Oct. 1964.

To aid in forecasting of future trends in the design of trash collecting vehicles, some statistics on the physical properties of waste are compiled. In 1961, the average specific weight of municipal waste was 350 kg per cu m, generated at a daily rate of 2.25 liter per inhabitant. These numbers can be projected to become 300 kg per cu m and 2.8 liter per inhabitant for 1964, and 250 kg per cu m for 1970. These forecasts for the specific weights are confirmed by the observation that only 11.5 percent of the households have central, remote, oil or gas heating systems and that this share will not change substantially in the near future for socio-economic reasons. The volume will continue to increase for some time to come. This is mainly due to increased use of packing material which rose from 32.2 kg per inhabitant in 1950 to 84.6 kg in 1962. Commercial and bulky waste together constitute less than 7 percent of the municipal waste; their specific weight is estimated to be around 100 kg per cu m. For industrial waste average values are not useful since they depend too much on the various industries. (Text-German)

**64-0169**

Anderson, R. L. Refuse collection equipment and manpower requirements. In American Public Works Association Yearbook, 1964. Chicago, American Public Works Association. p.149-152.

Twelve conditions influencing service and costs are discussed. The Solid Wastes Committee is currently working on sophisticated analysis of a comprehensive refuse survey. There is no prospect for any dramatic breakthrough to revolutionize equipment or manpower requirements of refuse systems, but there is room for continuing improvement in management, equipment and techniques to be applied by alert and imaginative administrators.

**64-0170**

Australian town develops its own collection system. Refuse Removal Journal, 7(9):74, Sept. 1964.

Trash collection in Waverly, New South Wales, Australia is described. Present day practice is compared with that of the past. The collection trucks unload into a collection trailer, which transports the rubbish to the city dump.

**64-0171**

Backyard service improved by use of small vehicles. Refuse Removal Journal, 7(1):24, Jan. 1964.

Trash collectors now drive small three-wheeled satellite vehicles into the backyards of Claremont, California. This innovation has saved $10,000 per year in salaries, lessened back injuries, and freed trucks from waiting at curbs for backyard trash pickups.

**64-0172**

Biggest-ever cleansing exhibition. Public Cleansing, 54(12):1325, Dec. 1964.

The equipment exhibition at the German Conference at Munich is reported. Equipment included refuse collection trucks (where the accent is on dustless loading), tractors, sewer cleaning vehicles, sweepers, and bulk containers.

**64-0173**

Bowerman, F. R. Los Angeles develops transfer stations for eight large trailers. Refuse Removal Journal, 7(10):16, Oct. 1964.

Transfer stations in general and in Los Angeles in particular are discussed. There are two kinds of transfer stations--a direct one and one in which the refuse is rehandled. State motor vehicle codes provide the guideline for the measurements of the transfer trucks. Los Angeles uses a direct station that allows for storage of refuse during peak periods. Los Angeles is also experimenting with the use of sewage to transport some solid wastes.

**64-0174**

Bowerman, F. R. Transfer operations. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p. 75-79.

The transferring of refuse from the relatively small collection vehicle with its limited payload to a large bulk-hauler is not a new practice; such systems have been in use for a number of decades. It is an axiom in materials handling that each time a material is re-handled, the total cost rises; this is the principal advantage that direct dump transfer stations have over other types using storage and re-handling. However, another equally important axiom in materials handling is that intermediate or re-handling steps are justifiable if the net effect is a reduced unit cost for handling. Usually the latter results from a compacting step which increases the density of the material and allows more units of weight to be handled in the same space. State motor vehicle codes usually stipulate permissible gross tonnages for highway hauling and add certain limits on wheel and axle loadings. The ultimate goal of refuse transfer stations is to provide for the transferring of refuse at an optimum spacing to minimize non-productive travel of refuse collection vehicles. A number of schemes appear to be competitive: the use of pit and crane for overhead direct loading of trailers; the use of shaker pans or belt conveyors designed to accept sudden influxes of large quantities of refuse; and the use of containerization or baling as a step just prior to loading the transfer vehicle.

**64-0175**
British city installs new refuse transfer system. Refuse Removal Journal, 7(6):33, 36, June 1964.

To solve their disposal problem for 34,000 tons of refuse each year, the City of Preston, England, decided to use a 600 acre tract landfill area 7 miles from town. Since it would be economically unfeasible for collection trucks to make the daily 14-mile round-trip haul, the old existing incinerator was demolished and a modern transfer station was constructed in its place. Refuse collection vehicles drive into the facility at ground level and dump their loads onto a concrete-floored area measuring 125 x 85 ft. A small caterpillar-type bulldozer, with an 8 ft blade, pushes the refuse through two loading chutes in the concrete floor. Rubbish falls through openings directly into top-loading transfer vehicles. Two 49 cu yd and two 38 cu yd capacity carriers transport the solid waste to the landfill area. The average depth of fill is 14 ft, and it is estimated that it will take 110 years to use up the entire site.

**64-0176**
Calculation of rental charges and financing equipment purchases. In Solid waste disposal and municipal equipment ''rental''. New York, Buttenheim Publishing Corporation, June 1963. p.71-76.

To make a motor-equipment pool self-supporting the rental charges should include the cost of operations and depreciation. The operating charge not only includes direct costs such as gas, oil, repairs, and servicing, but also a share of the overhead cost. The true cost of operating city-owned equipment includes such factors as insurance, licenses, taxes, building maintenance and depreciation, rents, light, heat, water, telephone, etc. The most difficult of all costs to administer is probably that of equipment's operating life. However, equipment suffers its greatest loss in value during the first year or two, and rarely does it lose all of its value. Rental systems that include depreciation automatically allow for the purchase of a replacement piece of equipment.

**64-0177**
Chicago considering new transfer sites. Refuse Removal Journal, 7(1):34, Jan. 1964.

The City of Chicago is considering a plan to establish three special collecting and transfer sites for bulk trash, one each in the north, central and mid-south sections of the city. This plan might eliminate the inefficiency of hauling bulk trash to a central dump, where each load wastes a great deal of space.

**64-0178**
Chicago sanitation bureau 'sells' community on its daily service. Refuse Removal Journal, 7(12):10, Dec. 1964.

Chicago's Sanitation Bureau which employs 3,000 men is a 'tightly run ship.' Fifty ward superintendants keep the Commissioner informed about collections, damaged city gear, etc. Foremen are authorized to write tickets for some 35 sanitation offenses. Chicago's 15,015 alley blocks are hazardous for sanitation men, for they are unpaved, muddy after rains, slick with ice in the winter, and infested with rats.

**64-0179**
Cobey markets new side-load packer. Western City, 40(7):49, July 1964.

The Cobey Corporation offers a new side-load packer and refuse body available in 16, 18, 20, and 24 cu yd capacities. Refuse emptied through the side door openings is forced to the rear of the body and compacted with pressure up to 79,500 lb by a packer platen. This platen is operated by an injection arm and double-acting hydraulic cylinders. There is less cylinder packing, less strain and wear on each section, and dead weight is eliminated. There is also a topslide opening door through which the most bulky refuse can be loaded.

**64-0180**
Collection by train. Public Cleansing, 54(4):855, Apr. 1964.

The train is composed of small containers for the purpose of maintaining a twice-weekly collection. This operation, which takes place in Valdosta, Georgia, eliminates the expensive replacement of compression-type vehicles. Three small trailers are pulled by a small four-wheel-drive vehicle. In the collection, a man brings the bin to one of the trailers for emptying. One man is assigned to each trailer and they arrive for emptying the bins in sequence. As the man empties his bin, he steps into the pulling vehicle and draws the train forward ready for the next man to arrive. The tractor unit is equipped with a two-way radio to contact a larger packer truck when the train is full. The cost of the train is $6,000 less than a compaction type vehicle, its operation and maintenance is 20 percent of the cost of the vehicle it replaces, and savings in labor, is $5,000 per train per year.

**64-0181**
Colorado School of Mines Research Foundation, Inc. The transportation of solids in steel pipelines. Golden, 1963. 125 p.

Current interest in the transportation of solids in steel pipelines has pointed out the necessity for a comprehensive compilation of information pertaining to this mode of conveyance. Data were collected from the technical literature in order to make it available to industry in a form useful for preliminary design studies. Included are chapters dealing with the theoretical and practical aspects of designing, operating, and maintaining a solids pipeline as well as data sheets of successfully operating pipeline systems. Some of the types of materials being transported in these systems are: borax plant refuse, cleaning plant refuse, coal and coal refuse, power plant fly ash, gold slime, uranium-bearing gold slime, sand fill, and iron ore tailings. An extensive bibliography is appended. (The preparation of the Technical Committee on Pipe of American Iron and Steel Institute, New York, N.Y.)

**64-0182**
Colorado School of Mines Research Foundation, Inc. Pneumatic transport of solids in pipelines. In The transportation of solids in steel pipelines. Golden, 1963. p.55-56.

Pneumatic transport in pipelines has been used commercially in transporting granular solids for many years. Advantages of pneumatic transport of solids are as follows: straight line conveying is eliminated, one system can serve any number of feeder or discharge points, dust hazards are eliminated, handling losses are low, and the operation is clean and safe. Disadvantages include high capital cost, high power cost, and the fact that the system is uni-directional. Pneumatic transport systems can be classified according to their air requirements and their operating pressures. The system usually includes the following four components: a conveying pipeline; a prime mover such as a blower, exhauster, or pneumatic pump; a feeder to introduce the solids, a dust collection system at the discharge point. The effects of various parameters--such as pipe diameter, size, shape and amount of solids; and gas velocity on friction losses in a pneumatic transport system are not yet completely understood. The most comprehensive theories on vertical and horizontal pneumatic transport of solids are summarized.

**64-0183**
Contractor replaces fleet every four years. Refuse Removal Journal, 7(5):16, 24, May 1964.

Sanitation Service Company in Santa Barbara, California, sells its trucks every 4 years to keep maintenance costs down while enhancing the total value of its fleet. The company's penny-accounting route-cost analysis breaks operations down to minute specifics, enabling the company to make improvements in tire, trucks and other equipment for efficiency. Despite a considerable increase in business, the firm has been able to reduce its fleet and trim its payroll.

**64-0184**
Convention literature averages ten pounds of trash per person. Refuse Removal Journal, 7(9):44, 54, Sept. 1964.

A recent convention of 800 teachers at an Atlantic City hotel added 8,000 lb (or 10 lb per person) to the normal amount of refuse collected weekly by one of the trucks of ABC Refuse Removal Service. This company has four Leach packers on International Harvester chassis and 300 one and two yard containers to serve 135 hotels, restaurants and commercial stops, two golf clubs, and the State Marina, a series of long docks.

**64-0185**
Danforth, H. L. Train transfer garbage operation makes for quick, quiet service in Tucson. Western City, 40(4):24-25, Apr. 1964.

Tucson has found that their new train transfer system is economical. On most routes garbage is picked up by an International Scout towing 3 containers. When these containers are filled, the garbage is transferred to the 'mother truck', having a 24 yd compaction type body with a front end loading device. Other such compactor trucks are used to pick up the heavier commercial stops. At Tucson, the average number of stops is 5,500 per day. Tucson has reports that there have been no vehicular accidents involving the trains since they were put in service [illegible] months ago. One of the most important aspects of the system is supervision. Transfer points, routes and pick-up schedules must be carefully pre-planned to keep the operation running smoothly. Though this system has met favorable public reaction, there has been a problem with spillage during the transfer from trailer to truck which must be corrected. This sytem is very flexible and can be arranged to fit various areas.

**64-0186**
Danforth, H. L. Tucson inaugurates train transfer collection system. Refuse Removal Journal, 7(1):8, Jan. 1964.

The train system for refuse collection, which consists of a towing vehicle and a varying number of trailer containers, was recently adopted by the City of Tucson, Arizona. Two advantages of this system are maximum maneuveribility in negotiating the city's narrow alleys and streets and flexibility in adjusting the load capacity of the vehicles to the area serviced.

**64-0187**
Davies, A. G. Central buying agencies for municipal vehicles. Public Cleansing, 54(9):1160, Sept. 1964.

Pros and cons of bulk buying, whereby authorities make joint orders for equipment from manufacturers in an attempt to reduce prices is considered. Disadvantages outweigh advantages, mainly because central buying would tend to create monopolies.

**64-0188**
Davies, A. G. Why not mammoth collection vehicles. Public Cleansing, 54(4):343, Apr. 1964.

The problem of refuse transport over a considerable distance is considered. The bulk haulage vehicle operated from a transfer station is costly, unsightly, and perhaps unsanitary. The use of three-axle, six-wheel refuse collection vehicles, capable of leading the whole day's refuse with only one journey to the point of disposal is recommended. To accomplish this, improved compression units must be manufactured. The cost advantage of this system over both the transfer station and haulage by the conventional refuse packer trucks is outlined.

**64-0189**
Dead seals part of hauler's city contract. Refuse Removal Journal, 7(2):6, Feb. 1964.

The seal-collecting operation of Aladdin Sanitation & Engineering Corp. of Santa Monica and Malibu, California is described. The company operates a special unit which collects dead animals and 100 to 150 dead seals a year as well as regular refuse.

**64-0190**
Dustless loading. Public Cleansing, 54(10):1217, Oct. 1964.

Drawbacks to the dustless system of refuse collection and methods being employed in Great Britain to overcome them are discussed. The chief handicaps are the weight, costs, and the restrictions arising from the need to purchase a standard bin. Plastics have to some extent alleviated the weight problem, and one firm has developed a portable adapter for its shutters which allows the use of two types of bin.

**64-0191**
An editorial. Refuse Removal Journal, 7(5):26, May 1964.

The problem of recruiting the right kind of personnel for refuse collection results from the lack of pride of many sanitation employees in their work. An educational program for employees on the size and importance of the refuse and collection industry is necessary to instill a sense of pride in their work.

**64-0192**
An editorial. Refuse Removal Journal, 7(11):10, Nov. 1964.

Refuse collection operators often entrust expensive equipment to careless employees, then wonder why the value of such equipment depreciates so quickly. The refuse industry also suffers from the operator who treats his trucks well, but fails to keep them neat in appearance. A clean and efficient image is essential to good public relations in refuse management. A refuse contractor has a service to sell, and it must be pleasant. Workers should be neat and courteous and must display competence.

**64-0193**
Electro-hydraulic refuse lorry. Engineering, 198:631, Nov. 27, 1964.

A new electro-hydraulic refuse lorry exhibited by Eagle Engineering Company Limited is discussed. The principle employed in this vehicle is to have two electro-hydraulically operated moving barriers at the rear of the body that continuously force refuse toward the front and simultaneously compress it. The two sizes of refuse collection body now in production have capacities of 35 and 50 cu yd of uncompressed refuse. Rocking motion is derived from a pair of hydraulic rams, on each side of the body. The pump supplying the rams is driven electrically from the front of the vehicle engine. While tipping, the entire compression unit is raised clear of the discharged refuse.

**64-0194**
Fehn, C. F., J. O. Hall, M. Rosenthal, et al. Bulk storage and mechanized collection of combined refuse. Public Health Reports, 79(5):413-416, May 1964.

Recently developed systems for bulk storage and mechanized collection of combined refuse provide for in-place, mechanized transfer of refuse from bulk-storage containers to large-capacity compactor collection trucks. This system eliminates the need to transport bulk-storage containers to disposal sites. Capacities of containers range from .5 to 8 cu yd. They are constructed of heavy-gauge metal, can exclude small animals and insects, and are neither unsightly nor malodorous. Self-loading, compactor-type trucks empty containers at storage points in less than a minute. The process consists of: engaging the container with the truck's lift mechanism, lifting and inverting the container over the truck's opening, and righting the empty container. Special refuse storage bins, quantities of small containers, refuse separation and numerous personnel are not required, but operational difficulties do exist. Keeping the heavy doors closed, preventing indigents from obtaining shelter in them, and effective cleaning pose real problems. Valdosta, Georgia was one of the first cities to install such a container system. This city installed 278 containers and purchase two collectors. Businesses pay service charges, depending on volume collected. Savannah, Georgia also installed a similar system, employing 367 containers and two trucks. Schools, public housing authorities, and a few businesses reimburse the city for its use. Tables indicate refuse collection costs. With continued improvement, parks, roadside rest stops, and other recreational sites should gain benefits already enjoyed by commercial, industrial, and public housing areas.

**64-0195**
Garrison, W. T., O. T. Gay, and M. D. Bogue. Public Works, 95(6):121, June 1964.

Madison County, Alabama, has instituted a unique system of collecting refuse in rural areas. The key element of this new system is the use of detachable bulk-storage containers of 6 and 8 cu yd capacities, placed at strategic locations along roads and highways. Householders tore the refuse in the containers which are collected twice weekly by a packer truck.

**64-0196**
Getting rid of refuse. Fluid Power International, 29(336):95-97, Mar. 1964.

A special loading and transport system, known as the Maximum Payload (M.P.L.) and developed to overcome the problem of transporting large quantities of domestic refuse to disposal areas, is described. The system makes use of a refuse baling-press, a hydraulic power and control unit, and a new type of refuse transport vehicle. The baling-press reduces 80 cu yd of refuse into a single cartridge which is then loaded into the cylindrical body of the road transport vehicle. Details of each part of the system and its operation are given. The baling-press unit consists of a cylinder which is divided into a compression chamber, a charging chamber, and a piston-accommodation chamber and which is fitted with a loading hatch. All linear motions are hydraulically powered and controlled by the Vickers Sperry Rand 400-gal capacity hydraulic power unit with two pumps. The transport vehicle has a cylindrical body and is similar to those used by petroleum companies for bulk transportation of fluids. A uni-directional ejection piston is built into the body of the vehicle and is retracted by the introduction of the refuse-cartridge. This action applies sufficient pressure to maintain the cartridge-form during the trip to the disposal point and to eject the cartridge on arrival. The installation of the system at a refuse station on the Thames River is described.

**64-0197**
Householders prove one man's trash is another's treasure. Refuse Removal Journal, 7(6):37, June 1964.

Emptying homes of rubbish was the first phase of a cleanup program on Staten Island. The drive put New York's Sanitation Department three days behind schedule and prompted widespread scavenging by residents of one another's curbside rubbish. Householders' comments on the scavenging are also presented.

**64-0198**
Hydraulic press aids refuse disposal. Engineering, 197:202, Jan. 31, 1964.

A special loading and transport system to handle lightweight, less dense refuse is described. It consists of a refuse baling press and an entirely new refuse transport vehicle. The operation and construction of these units is discussed. The press is divided into a compression chamber, a charging chamber and a piston accommodation chamber. All linear motions are hydraulically powered. The refuse emerges from the press as a cartridge, 21 ft long and 7 ft in diameter and is pushed into the special cylindrical vehicle. A unidirectional ejection piston built into the vehicle applies pressure to maintain the cartridge form during its journey and finally ejects it.

**64-0199**
Johnson, B. B. Motorized refuse collectors. American City, 79(2):103, Feb. 1964.

The 16,000 population city of Claremont, California's success and savings in using small, crew-driven transfer vehicles to carry refuse from back yards to collection trucks is described. The city allows up to 400 lbs of refuse per residence. This system also enables the crew to cover more homes daily.

**64-0200**
Kaupert, W. German refuse collector types. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 10 p.

An alphabetical list describes the design and features of German refuse collectors. The Faun-Werke has been manufacturing the roller-drum refuse collector, the body of which does not give continuous loading. The degree of compaction does not meet present-day requirements. It is being superseded by a new type of compaction collector which makes possible continuous loading and greater compression. The Haller body has remained the same but had increased compression due to various improvements in construction. As soon as the pile of refuse has reached the required height, a screw located directly beneath the top of the receptacle carries it forward until the body below the screw is full, and the compaction process begins as refuse is squeezed through the screw. Keller & Knappich produces the KUKA refuse collectors which load refuse by means of tipper and conveyor wheel into a rotating drum with helical vanes. This type of body produces a homogeneous, uniformly-moistened refuse content, which helps to reduce dust formation during dumping. It is the only type that unloads without the need for tipping, with the same direction of rotation and raised-end cover. Magirus, like Faun, compacts the refuse as it is forced into the box-shaped body. The loading mechanism consists of two scoops, the filler or feed scoop, and the presser or charging scoop, which are synchronized and convey the refuse under pressure into the body of the vehicle. The Man refuse collector is designed for domestic, shop and bulky refuse in addition to providing bin-hoisting and tipping devices for indoor refuse containers, etc. Alternation of a conveyor with a presser plate forces the refuse in a rapid, continuous operation, achieving the desired compression.

**64-0201**
Kaupert, W. Modern vehicles and equipment used by German Public Cleaning Services. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 21 p.

Topics discussed are: refuse, which is categorized and the collector capacity given in relation to refuse volume and weight; the suitability of refuse collections in relation to size, compression, and hygiene; German refuse collector types, with a description of the design and features of the products of five German chassis- and body-constructing firms; and refuse collection with high capacity bins, which discusses the economic advantages as well as recommended specifications.

**64-0202**
Kunsch, W. M. Public Works, 95(3):105, Mar. 1964.

Waterbury, Connecticut, has a policy of replacing four of its twenty refuse collection packers with new units each year. This policy reduces maintenance costs. The operation of the city's landfill and incinerator are also described.

**64-0203**
Landman, W. J. Designed to work hard. American City, 79(3):106, Mar. 1964.

By efficient planning and building, Hempstead, New York 350,000 population, changed from contract to all municipal refuse collection, saving about 10 percent over contract rates. Their program is briefly explained.

**64-0204**
Lewis, W. A. The problems of bulk in refuse; Part III-- 'Collection' . Presented at Meeting of the Institute of Public Cleansing, Dundee, Scotland, Apr. 8, 1964.

The pattern for future refuse in Dundee, Scotland, is one of ever-increasing bulk. With respect to collection methods, all that this increase requires is adequate bin space. Lighter-weight receptacles are being considered, as the weight ratio between bin and contents is a definite disadvantage. If provision is made in the design of buildings for sufficient storage accommodation, great savings can be made in the number of collections each week. Collection from multi-story buildings would perhaps be most economical if the American system were employed, using containers of 4 to 12 cu yd capacity. Another method proposed for high flats would discharge refuse into a fixed hopper, from which the contents could be emptied with a vehicle underneath. Trade refuse collection can be made more efficient with the cooperation of shop owners in packing and storing refuse. Based on a recent test in Greenock, a load from 240 houses would weigh 3 tons 4 cwts and occupy 23 cu yd. Any of today's compression vehicles could accommodate this volume in one load. One problem arising is that the ratio between vehicle weight and refuse weight is becoming greater. Also, with the rising paper and cardboard content of refuse, it would be economical to initiate salvage collection. One method for this collection is the provision of a separate salvage section at the front of the vehicle body. The loss of refuse space in a compression vehicle would not be great.

**64-0205**
London's ire raised over dustless bin. Refuse Removal Journal, 7(5):4, May 1964.

The Streets Committee in a report to London's Common Council recommended the use of closed trucks and containers for refuse collection and storage. The city is buying the trucks, but it must overcome 'red tape' before it can purchase the special containers.

**64-0206**

Mammoth vehicles--mammoth headaches. Public Cleansing, 54(5):907, May 1964.

Anticipated difficulties in operating speculated mammoth-sized refuse collection vehicles of 50 cu yd capacity is discussed. These vehicles would need to be emptied only once a day and would transport the refuse directly to the disposal site. Problems of tip site maintenance with all deliveries being made within an hour in the evenings, the lack of maneuverability of large vehicles in tight areas and cul-de-sacs, and the probability of even longer hauls to dump sites are all considered impediments to acceptance of the large collection truck system.

**64-0207**

Manufacturer adapts refuse collection system to handle metals. Refuse Removal Journal, 7(7):13, July 1964.

The Transmission Division of Clark Equipment Company has installed a new refuse collection system in the Jackson Iron Works. The system, which collects scrap iron, has increased the contractor's per trip haul from 1.3 to 15 tons. The collection system includes a stationary hydraulic compactor.

**64-0208**

Meiller Kipper bulk container refuse unit. Surveyor and Municipal Engineer, 124(3761):45, July 4, 1964.

A hydraulically-operated handling unit, which can be mounted on a standard truck chassis, loads, carries and dumps full bulk refuse containers. The containers of varying capacities, designs, and types are independent of the handling unit and can be loaded by hand or dumper.

**64-0209**

Memorandum of evidence on refuse collection. Chartered Municipal Engineer, 91:29-30, Jan. 1964.

The possibility of refuse collection methods being a source of litter and the problem of unauthorized private dumping are both reviewed. The best method of collection is for the collector to take the storage container from the storage site and dump it in an adequately sized collection truck (preferably a dustless loading type). This results in a much cleaner collection system than curb collection, especially with a bonus system. Garden refuse should be composted and not collected. Builder's materials should not be removed free of charge. Abandoned cars which cannot be traced should be removed. A cooperative venture of several towns could provide the equipment at a central point to cope with the special problem of abandoned cars.

**64-0210**

Metro, A. A. No refuse refused. American City, 79(4):117, Apr. 1964.

Mayor Edward D. Bergin's citywide clean-up program for Waterbury, Connecticut, called for designating given collection areas well in advance, and placing a second notice in the newspaper with a collection time schedule to give people ample time to clean cellars, attics, and garages. Everything was picked up, regardless of size, shape, or weight. Street department crews followed the collectors to clean up the streets and gutters and patch the streets, and water-department personnel inspected and painted all hydrants. The special collection weighed in at 5,000 tons, and included refrigerators, stoves, water tanks, and bed springs. The outlying areas posed no problem because people could place rubbish on curb lawns and driveways. The central high-density area was another matter. To make room for the rubbish, all parking was banned a day in advance and on the collection day, and traffic was barred from narrow one-way streets. The collection force consisted of twelve trucks with Leach packer-type bodies and two open-body trucks. The campaign required 52 working days and covered every street in the city of 107,000.

**64-0211**

Municipal equipment 'rental'. In Solid waste disposal and municipal equipment 'rental'. New York, Buttenheim Publishing Corporation, June 1963. p.64-70.

An increasing number of cities administer their motor vehicles on a rental basis every year and many of them offer all types of equipment. The benefits include an upgraded standard of maintenance, a more orderly way to replace old and inefficient models with new models, maximum use of all equipment, and a positive knowledge of what it costs to operate the various pieces of equipment. The best method of managing municipal equipment is to establish a centralized equipment maintenance service including central control over the procurement and use of the equipment. Under such a system equipment of a specialized nature may be assigned to certain departments on a full-time basis to different departments as the need arises. Some cities find it possible to control all equipment through a central agency. In general this agency becomes part of the department of public works. A central control organization, by adopting the rental method, can become self-supporting. This requires careful administrative book-work. Examples of municipal rental are given.

**64-0212**
New cleansing depot and garage for Dumfries. Public Cleansing, 54(7):1004, July 1964.

Purposes of the new Cleansing Department depot at Dumfries, Scotland are to accommodate vehicles of that Department and others of the Council, to provide for vehicle maintenance, and deal with recovered waste products. A detailed picture of building layout and function on the unusual site is presented.

**64-0213**
New York City opens a $22 million sanitation department building. Refuse Removal Journal, 7(10):35, Oct. 1964.

A new central repair shop will house New York City's entire repair and maintenance unit, which services over 2,200 collection trucks and street cleaning units as well as other municipal vehicles. The shop will also be the headquarters for three refuse collection districts.

**64-0214**
No flying papers at this transfer station. American City, 79(6):26, June 1964.

This refuse truck-to-barge transfer station is completely enclosed in such a way that no refuse can blow around or float into the Thames River during dumping. There have been no complaints about this clean operation, and loaded vessels may easily transfer wastes to outlying disposal areas.

**64-0215**
Pedo, D. J. Reorganization cuts refuse collection costs. Public Works, 95(7):110, July 1964.

South Milwaukee, Wisconsin, which had an inefficient, unsanitary, and expensive system of refuse storage and haphazard collection routes, passed a refuse storage ordinance and revised its collection routes for greater efficiency and sanitation. A public relations campaign, which included the distribution of a pamphlet explaining the new ordinance, helped make the changes acceptable to the public and thereby to the city council.

**64-0216**
Pollock, K. M. Venice, without streets, moves refuse by water. Refuse Removal Journal, 7(10):10, Oct. 1964.

Venice, the Italian City which has canals instead of streets operates 25 refuse gondolas each with a two man crew and two metal containers. The refuse, the bulk of which is garbage, is transferred to scows, towed 20 miles out into the Adriatic Sea and dumped overboard.

**64-0217**
Preventative maintenance program helps keep Seattle's refuse trucks operating. Western City 40(5):47, May 1964.

The Washington National Disposal's fleet maintenance program keeps its 42 Leach Packmasters in tip-top shape and is still economical. Phase one of its 4 phase program consists of a daily soap and water wash down of each truck. Phase two has three maintenance operations:—1) basic maintenance service every 4 weeks; 2) tune-up every 12 weeks; and 3) service of the 'rolling' mechanisms every 48 weeks.

**64-0218**
Propose 105 mile pipeline to transport refuse in Germany. Refuse Removal Journal, 7(11):24, Nov. 1964.

Germany is considering a proposal to construct a 105 mile pipeline to carry garbage from northern Germany to the North Sea coastline, where it will be used to build up the land. Other methods of waste disposal have proved unsatisfactory. The pipeline would also transport waste water.

**64-0219**
Refuse collecting vans. Engineering, 198:619, Nov. 13, 1964.

Three refuse collection vehicles from a public works exhibition are briefly discussed. Made on the Swedish Norba system, they are: a manual loader, for ordinary collection; a dustless loader, for municipal bin schemes; and a dual purpose unit for both. Compression and choice of chassis are mentioned. Main attributes of the Norba system include: maximum payload; saving in tipping space; and solid tips. Any type of garbage, refuse and light scrap is acceptable to these vehicles.

**64-0220**
Relander, B. Collections pose major problem. Waste Trade World, 105(20):66, Nov. 14, 1964.

Finland has an increasing demand for waste paper as the result of modernizing and expansion of paper and board mills, with a demand in 1965 estimated at 125,000 tons, which will not be met at the present collection rate of 24 percent of the production of 400,000 tons. Because of the high charges for freight, large scale imports are expensive. While the paper collection from commercial sources is almost 100 percent, there is a problem in organizing collections from private homes and other small sources because the large country is so sparsely inhabited. The efforts to collect waste paper include thousands of collection points operated by junk dealers, co-operative stores, and private merchants all over the country. For every kilo of waste paper brought to the center, the collector receives coupons which enable him to buy wrist watches, cutlery, etc. at reduced prices in addition to being paid cash for the paper. Collections are made in the name of charities, with the paper being collected at regular intervals by professional truck drivers. Collections for charities are arranged several times a year by volunteers with the aim of effectively clearing the area of paper stocks. Janitors are either paid directly for waste paper from apartments or payments are made to trade unions. These drives are supplemented by propaganda through the press, radio, television, and schools.

**64-0221**
Report on the M.P.L. refuse transport system. Surveyor and Municipal Engineer, 123(3752):35, May 2, 1964.

The M.P.L. (Maximum Pay Load) system of household and industrial refuse transport, first installed at Hammersmith, is reviewed after 14 months during which time 11,743 tons of refuse was handled. To facilitate the employment of specialized vehicles, transfer stations were introduced at intermediate points between collection and disposal. At the Hammersmith transfer point, the refuse is compacted by press for transport to the disposal site 18 miles from the transfer station. The M.P.L. system is in essence a transport system designed to move larger loads in fewer trips and delivers a denser, more compact load which takes up less room at the dump.

**64-0222**
Roland, F. Illinois residential route adds 500 new customers per year. Refuse Removal Journal, 7(8):18, Aug. 1964.

Monarch Disposal Company of Wood Dale, Illinois, has renewed a 5 year contract with Elk Grove, a new community of 3,000 homes, still growing at a rate of 500 houses per year. Monarch also has other household and commercial routes in the Chicago area.

**64-0223**
Samans, H. Hygienic removal of garbage from markets. Staedtehygiene, 15(10):234, Oct. 1964.

The removal of garbage from markets in large cities by trucks is both uneconomical and unhygienic. In many German cities, among them Munich and Stuttgart, the garbage is collected by underground conveyor belts which transport the garbage to a heavy duty hammer mill, also installed underground. There the garbage is cut into small bits and sprayed with water. The resulting slurry is emptied into the municipal sewer system. Supplemented by a magnetic iron collector, the equipment accepts hard material like wooden boards and bottles. Some large hotels use similar garbage disposal systems. A hammermill is shown in two photographs. (Text-German)

**64-0224**
Self delivery is no help to collection. Refuse Removal Journal, 7(12):30, Dec. 1964.

The Kewalo and Kapalama incinerators at Honolulu are operating at full capacity with about 200 tons per day at each unit. Division personnel have to turn away individuals who deliver refuse, since the incinerators are not designed for do-it-yourself disposal. Individuals and businesses should have their trash in place for collection, to facilitate proper pick-up service. Tree trimmings, which are not cut into 36 in. lengths, have to be taken either to the Waipahu or Kailua landfills.

**64-0225**
Shih, C. C. S. Hydraulic transport of solids in a sloped pipe. Proceedings of the American Society of Civil Engineers Pipeline Division, 90(PL2):1-14, Nov. 1964.

The effects of pipe slopes on the energy gradient of the flow mixtures, as well as the functional relationships among the pertinent physical quantities involved in the transportation of solids by water in a pipe is discussed. Three slope angles of the pipe, horizontal, 8.73 degrees and 17.71 degrees, were used for the experiments and each different angle was tested exactly the same. The solids concentration was approximately 18 percent for all runs. These solids consisted of ½ in. wooden balls that had been soaked until they became waterlogged, giving them a specific gravity slightly greater than one. Three general conclusions, supported by evidence presented in tables and graphs, are stated as a result of the experiments: (1) For a given concentration of solids and flow rate, an increase in pipe slope causes a rise in head loss; (2) the effect of pipe slope on head loss becomes more pronounced for higher solids concentrations; and (3) the rise of head loss for a given pipe slope is caused by the increase of either the solid concentration or the flow rate of mixtures.

**64-0226**
Snow thoughts in the sunshine. Public Cleansing, 54(9):1132, Sept. 1964.

The vehicle and appliance exhibition at the 66th annual conference of the Institute of Public Cleansing in Margate, England is discussed. Equipment included snow cleaning appliances, refuse collection vehicles, bins, bulk containers, mechanical sweepers, pulverizing units, and tractors. A trend toward compression collection vehicles with continuous loading mechanisms and increased use of plastics in brushes, bins, trucks, and protective clothing is noted.

**64-0227**
Southwark new refuse transfer station. Surveyor and Municipal Engineer, 123(3747):46, Mar. 28, 1964.

The new Southwark Borough refuse transfer station, designed to replace the rail conveyance of refuse to the dump at Longfield in Kent by trucks, is described. The local collection vehicles dump their refuse on an elevated platform. The refuse is pushed through slots in the platform by a loading shovel into the bulk transport trucks on a low level road under the platform for the 25 mile trip to Kent. The concrete structure has no ledges and water is available for hosing the platform and for water sprinkler nozzles to control dust when required. The through put of the station will be 34,000 tons per year and will contribute to the increased efficiency of the refuse removal procedures.

**64-0228**
Special trailers solve Miami's hauling problems. Refuse Removal Journal, 7(4):6, Apr. 1964.

A special trailer had to be designed to improve the hauling of tons of non-burnable matter and incinerator residue from Miami's two incinerators to a single municipal landfill site. Formerly, the non-combustibles were hauled through the streets in open-body dump trucks, causing complaints from the householders about the stench, the spillage of tin cans, and the streams of ash-saturated water that dribbled from the tailgates of the vehicles. The body of the new trailer is completely closed, yet low enough in height to clear the top of the incinerator ash tunnels. It has a one-piece, cylindrical, all welded steel frame and body, equipped with a hydraulic packing mechanism. The problems Miami encountered in searching for landfill sites are also described.

**64-0229**
Stirrup, F. L. Transfer loading stations. London, The Institute of Public Cleansing, 1963. 56 p.

The scope and method of investigating are reviewed. A detailed examination of existing methods covered the following: a converted destructor plant, borough of Hornsey; simple transfer stations, boroughs of Hammersmith and East Barnet; a transfer depot with par separation, borough of St. Pancras; a tra depot with full separation, city of Salford. Possible future developments include extraction of materials for salvage, reduction of volume by bulldozer, pulverizing, pulverizing-Gonard system, compression within the vehicle, and compaction within the depot. The conversion from road to rail transport is discussed. Costs for separation and baling, transfer loading, controlled tipping and incineration, depots and overheads, allocation of load charges, and refuse baling tests in the city of Salford are also covered. The appendices itemize the costs of the various operations.

**64-0230**
Stragier, M. 'Refuse wrangling' in the old west. Western City, 40(9):50, Sept. 1964.

Scottsdale, Arizona, 'The West's Most Western Town' , has set up a train transfer system for their 13,000 residential and 750 commercial accounts. Their trains have 3 trailers towed by a Dodge pickup mounted with an extra container in place of the pickup bed. They haul about 400 compacted yd per day, 6 days per week from a town of 44,000. Each train ( 'calf' in Scottsdale) services an average of 870 residences per day. The packers ( 'cows' ), with 28 yd bodies, can easily contain 3 to 4 calfloads. The foreman, inspector and superintendant are known as 'bulls' and the crew wears western style uniforms. Because the crew made such an impression with the children, the city offered honorary membership in the Refuse Wranglers for any child who kept the alley behind his home clean.

**64-0231**
Tchobanoglous, G., and G. Klein. An engineering evaluation of refuse collection systems applicable to the shore establishment of the U.S. Navy. Berkeley, University of California, College of Engineering and School of Public Health, Feb. 28, 1962. 478 p.

On May 20, 1959, the Navy entered into a 2 year contract with The Regents of the University of California covering the refuse collection operations of the shore establishments of the U.S. Navy. Refuse production and collection were studied at all facilities at each selected activity. The areas covered include: office buildings, stores, grounds, ships, and housing areas. The systems investigated were hauled-container and stationary-container systems, with and without transfer stations for transfer from collection vehicle to haul vehicle. The types of equipment studied include self-loading collection vehicles, collection vessels, large trailers, and compacting and non-compacting vehicles as well as the equipment used at different types of transfer stations. Cost estimates were made for equipment, labor, and operating expenses. Work methods and time-study data for refuse-collection operations were obtained by a survey team. A comparative economic analysis between five different collection systems, for the collection of rubbish from three typical naval installations producing about 9.7, 19.4, and 29.1 cu yd per day of rubbish, found that the system using self-loading compactors was the most economical, regardless of the haul distance.

**64-0232**
Tchobanoglous, G., and G. Klein. General considerations. Refuse production. In An engineering evaluation of refuse collection systems applicable to the shore establishment of the U.S. Navy. Berkeley, University of California, College of Engineering and School of Public Health, Feb. 28, 1962. p.17-46.

Data are presented on refuse production and a classification of refuse collection systems. A classification of refuse and definition of terms is given. Some of the more important factors which affect the type and quantity of refuse produced from naval installations (exclusive of domestic refuse from naval housing areas) include the following: type of facility, level of activity, and climate and geographical location. The overall rubbish production rates and number of rubbish pickup points for five naval installations are compared and tabulated. It was found that the distribution of quantities of rubbish production from pickup points followed a similar pattern at each of the installations--28 percent of all pickup points generated a quantity of rubbish in the range of 0 to 5.0 cu yd per week. Refuse production data for specific facilities cover: buildings producing rubbish only; commissary and exchange stores; civilian cafeterias, Navy galleys, and service clubs; ships; piers, docks, berths, and shipbuilding ways; and station grounds. Where possible, daily refuse production data for facilities were subjected to statistical analysis. The quantity of domestic refuse collected from housing facilities operated or used by the Navy depend on factors such as: packaging, garbage grinders, incineration, and collection frequency. Three typical naval housing areas were studied in Northern and Southern California. The systems were classified as to mode of operation, equipment used, and the type of refuse collected.

**64-0233**
Tchobanoglous, G., and G. Klein. Hauled-container systems. In An engineering evaluation of refuse collection systems applicable to the shore establishment of the U.S. Navy. Berkeley, University of California, College of Engineering and School of Public Health, Feb. 28, 1962. p.47-98.

The hauled-container systems ovserved during this study can be classified into the following three categories: hoist-truck system, frame-loaded container system, and trash-trailor system. The equipment used in hoist-truck collection systems consists of open or covered metal containers, generally ranging from 2 to 15 cu yd in capacity, and of one or more truck bodies on which is mounted a mechanism capable of hoisting the containers from the ground to the truck and of discharging the container contents. The frame-loaded-container system also has one driver and truck perform collection and haul. The containers are usually larger (10 to 40 cu yd) and are slid onto the truck on a special frame. Usually they are dumped by tilting the frame and are especially suited for collection of non-putrescible rubbish. The trash-trailer system consists of large semi-trailers, which are used as storage containers, and a tractor for hauling. At the disposal site, trailers require auxiliary power equipment and personnel for unloading. This system is used for areas with high rubbish production rates. Maintenance, health and safety aspects, operation, typical costs of owning and operating are discussed for each system. The containers and vehicles are illustrated.

**64-0234**
Tchobanoglous, G., and G. Klein. Stationary-container systems. In An engineering evaluation of refuse collection systems applicable to the shore establishment of the U.S. Navy. Berkeley, University of California, College of Engineering and School of Public Health, Feb. 28, 1962. p.99-174.

Stationary-container systems are those in which the containers used for the storage of refuse remain at the point of refuse generation and refuse from a large number of containers is loaded into the collection vehicle before a trip to the disposal site. The stationary-container systems include those employing self-loading compactors, those employing manually loaded vehicles, and those employing vessels. The self-loading compactor system consists of open or covered containers and collection vehicles equipped with a loading mechanism capable of unloading the contents of the containers into the body of the vehicle. The capacity of the containers varies from 0.5 to 8 cu yd. The two types of operations involved in manually loaded vehicle systems are operations associated with the appearance of the station and its grounds and the collection of refuse from housing areas. The containers range in size up to 55 gal oil drums and the vehicles are compacting or non-compacting trucks varying in capacity between 9 and 30 cu yd. Refuse produced aboard ships is collected with the aid of YG scows and LCM's. Personnel, collection procedures, survey data, disposal sites, and typical costs estimates are included for each system. The containers, trucks, and ships are illustrated.

**64-0235**
Tchobanoglous, G., and G. Klein. Systems employing transfer operations. In An engineering evaluation of refuse collection systems applicable to the shore establishment of the U.S. Navy. Berkeley, University of California, College of Engineering and School of Public Health, Feb. 28, 1962. p.175-260.

The employment of transfer operations is either dictated by necessity, such as in the collection of refuse from moored ships, or indicated as a result of economic considerations. Refuse, collection bodies, or containers may be transferred from the collection to the haul vehicle with or without the aid of a transfer station. Transfer methods, facilities, equipment, sanitary conditions, vehicles, personnel, costs, and economic considerations are covered for small, medium and large capacity transfer stations, stations employing compaction facilities, and stations used in conjunction with ships and collection vessels. Systems where transfer takes place from a collection to a haul vehicle without the benefit of fixed transfer station facilities employ loaders and trailers; dump trucks, fork-lift loaders, and specially designed containers; and two trucks equipped with frame-loading mechanisms. Equipment, vehicles, and operational data are discussed and illustrated.

**64-0236**
Tchobanoglous, G., and G. Klein. Design of refuse collection systems. In An engineering evaluation of refuse collection systems applicable to the shore establishment of the U.S. Navy. Berkeley, University of California, College of Engineering and School of Public Health, Feb. 28, 1962. p.261-311.

The procedures which can be used to design and evaluate collection systems and operations are outlined. The conditions which must be evaluated before a suitable system can be selected are: refuse production; number and location of pickup points; refuse production rates; disposal methods and sites; physical characteristics such as climate, topography, and layout of streets; and health, safety, and aesthetic considerations. Systems and equipment which may be used are summarized in a table. Design entails determining container, labor and vehicle requirements, and laying out collection routes for hauled-container or stationary-container systems and/or systems using transfer stations. A typical analysis of the relative economy of equivalent refuse collection systems is illustrated. Container, equipment, and operating costs are considered as well as round-trip haul distances. For the systems examined and assumptions noted, the system using a self-loading compactor was found to be the most economic for any practical haul distance at each of the three sizes of installations considered.

**64-0237**
Three-wheel carts double number of daily collections. Refuse Removal Journal, 7(5):34, May 1964.

Cleveland Heights, Ohio, has switched to small, three-wheeled vehicles to hoist trash cans from back yards to curb-side pickup areas and has thereby increased the number of household stops from 300 to 700 per day and trimmed its manpower requirements from 76 men to 52.

**64-0238**
Tompkins, V. Truck-mounted chipper-container. American City, 79(12):18, Dec. 1964.

Walla Walla, Washington, has mounted a brush-chipping unit with a container to store tree chips on a refuse packer. The completed unit is compact and flexible for easy on-the-spot removal of brush.

**64-0239**
Tottenham's policy on clearance of blockages in refuse chutes. Public Cleansing, 54(10):1199, Oct. 1964.

Tottenham, England, has instituted a special unit to clear stoppages in chutes and to clean and disinfect chutes and receiving containers. The unit consists of two men and a delivery-type vehicle with a rear tail lift, which elevates containers into the truck. The vehicle is also equipped with chute clearance rods, grapnels, water hose and reel, water kegs, brooms, shovels and disinfectant.

**64-0240**
Transfer station saves nearly $100 a day. American City, 79(9):25, Sept. 1964.

A transfer system initiated in Abilene, Texas in Mar. 1961 resulted in savings of $95.55 a day. Abilene's transfer station consists of an earth fill ramp from which the packers discharge refuse through a funnel-like hopper into the trailers. Two Hobbs Hyd-Pak trailers, of 42 cu yd capacity each, service the four small and six 16 yd collection trucks. The hopper sides combine with the trailer's folding roof doors to guide the refuse into the trailer. Remote controls enable the collection truck drivers to start the trailer engine and packing cycle from the upper level of the transfer station. The transfer system also improves the use of manpower and permits more efficient scheduling of collection vehicles.

**64-0241**
Trow, J. Vehicle test in Sheffield. Public Cleansing, 54(7):990, July 1964.

Sheffield, England, has added a Dennis Poxit Major III and a Sheroke and Drewry 35 cu yd Pakamatic to its refuse collection fleet of about 80 Shefflex vehicles. All its vehicles have incorporated into them a rear low loading mechanism that requires bins to be lifted only 2 ft off the ground.

**64-0242**
Tyson, C. B. Refuse collection train improves service. Public Works, 95(1):99, Jan. 1964.

Valdosta, Georgia, has switched to refuse collection trains, which consist of three 4 yd Lo Dal containers mounted on wheels and towed by an International Scout. Packer trucks dump the contents of the trailers into their bodies. The reason for the switch is that the initial purchase price, operating costs and manpower requirements are less for a train than for the conventional collection system of packers.

**64-0243**
Vehicle and equipment exhibition. Public Cleansing, 54(6):947, June 1964.

The vehicle and equipment show at the Eighth International Congress on Public Cleansing in Vienna is reported. The display include the Purswagen, a refuse collection vehicle manufactured in the Netherlands with mechanical loading, continuous feed and partial compression; the Kuka compression vehicle which accepts bulky items; and the Lesa-Unimog vehicle which has no back wheel axle, uses front-wheel drive, and is used for bulk containers.

**64-0244**
Vehicles. Public Cleansing, 54(2):812, Mar. 1964.

A meeting of the Junior Members' Discussion Group in Glasgow, Scotland is reported. The meeting consisted of a demonstration of modern refuse collection vehicles, street cleaning vehicles, and mechanical gully emptiers, and a discussion of such topics as loading capacity, crew accommodation, equipment for bulky wastes, and suction sweepers.

**64-0245**
Vehicles on hire in Lanarkshire now. Public Cleansing, 54(12):1316, Dec. 1964.

According to its annual cleansing report, Lanarkshire, Scotland set up a central Transport Department to provide and maintain vehicles for other county departments.

**64-0246**
Walla Walla designs mechanized brush chippers. Western City, 40(8):34, Aug. 1964.

In order to increase mobility and efficiency a Pak-Mor barrel packer was mounted on a 1957 Ford V-8 chassi which was first shortened by cutting off the front end of the barrel to allow space to mount the chipper. In order to get the chips into the packer, a round galvanized pipe 13 in. in diameter and 12 gauge sheet metal was manufactured. The unit is very compact and flexible and solved the brush and limb disposition problem at Walla Walla.

**64-0247**
Wallis, H. F. Gaps in the refuse collection services. Public Cleansing, 54(3):770, Mar. 1964.

A memorandum on refuse collection submitted by the Council for the Preservation of Rural England (CPRE) to the Ministry of Housing and Local Government is reported. The CPRE recommends strong regulations for the provision of adequate dustbins by householders, builders and others; weekly collection; elimination of roadside pickups; provision for removal of bulky refuse by local authorities; a regular review of the number and size of litter bins; and incentive schemes to boost employee morale.

**64-0248**
Wrong body and chassis combination may have drastic effect on costs. Refuse Removal Journal, 7(12):24, Dec. 1964.

Guidelines for selecting new equipment for refuse collection vehicles are presented. The refuse collector should keep in mind that the true costs are those run up by the unit during its entire life cycle, not just the first costs. Some factors to be considered are operating costs and maintenance labor costs.

**64-0249**

Xanten, W. A. Waste collection, storage, and transportation. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.65-68.

Two broad categories of solid wastes are discussed: refuse incident to the ordinary conduct of a household (including yard refuse); and all other special categories inclusing commercial and industrial wastes. Because of the differences in methods of approach, nomenclature, record keeping, cost accounting, and a number of other variables, cost comparisons between cities is not only difficult, but can be dangerously misleading unless carefully interpreted. Great strides have been made in the areas of improved collection equipment, containerization, and the design and operation of transfer and marine loading stations. As a community increases in size and complexity the solid waste problems mount in a geometrical rather than an arithmetical progression. Such elements as lengths of haul, requirements for more expensive disposal mechanisms to maintain high-level and nuisance-free sanitary controls, dense traffic patterns, higher service frequencies, etc. all tend to emphasize the need for adequate administration and management and careful long-range planning. It is claimed that a research project has been recommended to establish the intrinsic value of compost in the United States in collaboration with the Department of Agriculture.

**64-0250**

Yankee contractor 'sweetens' clients with scented trash. Refuse Removal Journal, 7(4):8, Apr. 1964.

The Elm City Sanitation Service which services ten communities of southwestern New Hampshire sprays its loaded household collection with pine scent frequently and washes its truck daily. Other ways in which the company tries to enhance the popular concept of refuse collection in the area it services are also described.

## DISPOSAL–General

**64-0251**

American City Magazine. Solid waste disposal and municipal equipment 'rental'. New York, Buttenheim Publishing Corporation, June 1963. 82 p.

A series of articles that appeared in The American City, which are of use for reference purposes and in-service training, are presented. The first section is a collection of papers on various phases of refuse disposal, delivered originally at the Solid Wastes Conference held at the University of Pittsburgh. These papers cover: the sanitary landfill, incinerator design, planning municipal composting, compost plant design and operation, combined disposal of sewage compost plant design and operation, combined disposal of sewage sludge and refuse, an over-all engineering evaluation, the area-wide approach to refuse disposal, and composting costs in Israel. The second section deals with the interesting growth of municipal motor equipment departments that own, maintain, and rent the equipment to the operating departments, and through this arrangement they pay for the maintenance and purchase of new equipment as needed. The rental rates are especially revealing as an indication of operating costs.

**64-0252**

Antarctic refuse problem. Public Works, 95(7):118, July 1964.

The method of refuse removal used by the United States McMurdo Station in Antarctica is to pile the refuse on the ice covering the bay in front of the station; annually, when the ice breaks up, the refuse is carried out to sea. This method worked well from 1955 to 1962. However, in 1963 the ice failed to break up on schedule and, as a result, nearly two years' refuse has accumulated. Fortunately this is not serious, since there are no winged insects in Antarctica to breed in the garbage, and the cold prevents decomposition. The refuse cannot be buried since the ground is always frozen, and it can be burned only under rigidly controlled conditions, because of the fire hazard involved.

**64-0253**

Automated waste disposal. Safety Maintenance, 128(3):55, Sept. 1964.

The typical belt-fed incinerator, such as that in Girard, Ohio is described. Details of the building for unloading refuse, the sorting area to collect salvageable materials, the hinged-steel belt conveyor system, the burner, and the forced air system and control center are presented.

**64-0254**
Await report on dumping in ocean by 12th largest liner. Refuse Removal Journal, 7(11):34, Nov. 1964.

The S. S. Caronia, charged by the Federal Government and the State of New Jersey with dumping refuse into offshore water, was granted a delay in the proceedings until they could conduct their own investigation of the incident. The case is expected to be settled out of court.

**64-0255**
Baumgartner, D. J. Water supply and waste disposal problems at remote Air Force sites in Alaska. Technical Note No. TN-62-1. Fort Wainwright, Alaska, Arctic Airomedical Laboratory, Mar. 1063. 6 p.

Wast disposal and water supply problems at remote Air Force sites are presented. These problems affect health, well-being, aesthetic conditions, and convenience, which influence man's ability to function effectively in cold environments. Specific problems and their solutions are discussed and illustrated. Examples include: disposal of waste in areas where water is not readily available. An aerobic recirculating waste system for conservation of water and disposal of wastes has been developed to solve this problem. In circumstances where privies or bucket toilets are in use, continued efforts to develop electric incinerating toilets are warranted. The main objective is the provision of equipment which requires little maintenance and performs adequately under the environmental conditions at remote installations. (Defense Documentation Center for Scientific and Technical Information AD-411 319)

**64-0256**
Bell J. M. Characteristics of municipal refuse. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.28-38.

Present methods of sampling and analyzing municipal refuse, present research, and recommended studies are discussed as a spin-off from research work done at Purdue University during the last 6 years toward the development of a practical and reliable technique for sampling and analyzing municipal refuse. Field studies were conducted in order to obtain samples of refuse for laboratory analysis as well as to estimate the accuracy of the method used in obtaining these samples. Sample areas were selected by stratified random sampling after the city had been classified into high, medium, and low socio-economic strata on the basis of housing and/or property market value. A logarithmic relationship was found between the sampling ratio and the average percent sampling error. A linear regression analysis was made by the method of least squares. The linear equation is given. The entire quantity of each material received was shredded to a maximum size of 2 to 3 in. A 'representative' sample of from 1,000 to 3,000 g of the material was selected and placed in a plastic container and dried to a constant weight of 70 F. Weighings were made before and after to determine percentage of moisture and then ground to a maximum 2 mm for chemical analysis. The methods of laboratory analyses are outlined. A list of recommendations for future research is offered. It is concluded that a better understanding of the chemical composition of refuse will facilitate the design of more efficient recovery methods for utilizing part of the refuse as part of a planned conservation program.

**64-0257**
Braun, R. Analysis and valuation of solid refuse with regard to incineration and composting. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 3 p.

The quantity, the nature, and the composition of the refuse to be processed must be estimated when planning solid refuse treatment either by incineration or by composting. Refuse may be either reduced to its different ingredients and analyzed afterwards, which is tedious and inaccurate, or the whole sample can be ground, homogenized, incinerated and analyzed. The Public Cleansing Department in Vienna has used a large calorimeter to determine values after incinerating the contents of a garbage can with a gas flame. This method, which has been later improved, obviates the tedious sorting and preparing of the samples, but requires a large number of determinations. A simpler and more accurate method makes use of a mobile hammer-mill which grinds the refuse and reduces it to gross pieces which are then homogenized into typical samples of raw refuse. These are later dried, pulverized and analyzed in a powder state. Plants must be erected for the removal of refuse in general rather than solely for domestic refuse. Composting can be utilized for the sole purpose of converting refuse into humus or can be used to produce a saleable product which can be used for soil improvement. The compostibility of refuse must be determined and kinds of refuse which are in principle compostible are: domestic refuse, sewage sludge, and industrial refuse of an organic nature. Industrial waste may complicate the composting process due to its one-sided chemical composition, and preliminary processing may be necessary. The object of the investigation of the original material is to ascertain whether it guarantees a final product containing sufficient humus-forming substances.

**64-0258**
Braun, R. Analysis and valuation of the final products (incineration residues and compost). Presented at the Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 4 p.

The method used for the determination of the degree of incineration should consider calorific production and the dumping of the combustion residues. There is an economical limit which prescribes the degree the non-combusted material must be incinerated. There is a possibility that non-combusted organic particles when putrefied may have a harmful influence on ground water, but this danger with regard to incineration residues is not very great. The loss on ignition which is used as a measure for the incineration degree for solid fuels has doubtful application to the valuation of the incineration degree of refuse-slag in connection with the effect on ground water. Other methods of analysis are discussed. A compost improves in quality in proportion to its content of humus-forming substances, and the quality of the organic substances must be determined as well as the contents. The composition of compost is discussed with respect to research work and methods of analysis. The problems associated with the production of auxines during the putrefaction process of organic matter are enumerated. A standardization of the methods of analysis on an international level is necessary for correct interpretation.

**64-0259**
Bulk refuse handler. Engineering, 198:649, Nov. 20, 1964.

A bulk refuse handling unit made by Powell Duffryn Engineering Company Limited is described. The unit incorporates a dust sealed loading hopper and has a capacity of 6 cu yd. A range of sizes and types including an end-loading vermin-proof, fire-proof container are mentioned. This unit is best used in multi-story flats, markets, and abbattoirs.

**64-0260**
Burnley's solution to the rubbish dump. Public Cleansing, 54(3):801, Mar. 1964.

Burnley, England, has begun a campaign to reduce the problem of rubbish dumped on empty lots by offering and advertising services to remove the rubbish.

**64-0261**
Carmichael, W. Changing composition of domestic refuse. Surveyor and Municipal Engineer, 123(3755):49-50, May 23, 1964.

The problem of the change in bulk of refuse and its effect on refuse disposal is discussed. In Edinburgh, the bulk of refuse has increased by 160 percent, but only 20 percent by weight in the last 15 years, while the density has been more than halved. The total volume of refuse collected is increasing at 7.5 percent a year; the total weight of combustible and organic matter is increasing at the rate of 20 percent a year, while the total weight of ashes (dust and cinders) decreases 5 percent a year. Dumps are being filled 60 percent quicker than ten years ago. The Edinburgh separation-incineration plant built to handle 240 tons of crude refuse a day in 1938 can handle only 150 tons today. For each 100 tons of crude refuse treated in separation and incineration plants, 60 tons have to be taken to the dump. Composting offers some dump economy. Refuse will continue to increase in bulk and decrease in density, requiring improvisation and adaption of existing methods and plants and difficulties in design of new treatment plants because of the changing composition of the refuse.

**64-0262**
Carmichael, W. The problem of bulk in refuse as it affects refuse disposal. Presented at Meeting of the Institute of Public Cleansing, Dundee, Scotland, Apr. 8, 1964.

From an analysis of Edinburgh's refuse over a period of 15 years, general tendencies in large cities can be expected to included augmented total bulk (with increasing population), increased amount of combustible and organic matter, and decreased percentage of ashes in refuse. A principal problem is scarcity of tipping sites, but reducing refuse bulk by increasing density (as by pulverization) would be helpful. Incineration or composting can aid in reducing both bulk and total weight. In many cases, the need for treatment plants has been accelerated by this scarcity of tipping space. Incineration is not only a satisfactory solution for disposing of low-density domestic refuse at present, but may serve extensively in the disposal of future refuse which may have even lower density and minimal ash content. However, increased concern with air pollution generates a need for alternative means of treatment, such as transfer plants working in conjunction with compressor bulk-carriers, pulverizers, or bulldozers. Increased bulk in industrial wastes can be kept manageable by separate waste paper collection. Data is provided to illustrate the average densities of refuse and the treatment of refuse.

**64-0263**
Clark & Groff Engineers. Sanitary waste disposal for Navy camps in polar regions. Part II. Final report. Port Heuneme, Calif., U.S. Naval Civil Engineering Laboratory, May 1962. 115 p.

Existing practices with recommendations for research and improved waste handling concepts for littoral and ice installations are summarized. Effects of the polar environment and military characteristics are evaluated. Present practices and research were investigated through field visits to artic installations, interviews, conferences, and correspondence. After the establishment of aesthetic and sanitary criteria, a broad spectrum of waste handling processes was evaluated and the most promising system concepts were selected. It was concluded that the regeneration of potable water from the sanitary wastes would solve the water supply and waste disposal problems simultaneously and entirely within the encapsulated environment of the polar camp. The proposed system consists of minimum flush tiolets, combination of all wastes, and regeneration by a high temperature oxidation (HTO) unit or by vacuum distillation with catalysis. In the event that water supply is not a problem, wastes can be collected; disinfected by waste heat, steam or electricity; and discharged to snow, ice sump or marine outfall. For isolated areas and small groups of men, a recirculating synthetic flushing fluid unit would give adequate solution to the human waste problem with optimum water conservation.

**64-0264**
Creisler, J. A whale of a problem. Public Works, 95(1):80, Jan. 1964.

Del Norte County, California, could not apply the conventional methods of disposal of dead marine animals to a whale stranded on South Beach, because the whale was still alive. After unsuccessful, humane attempts at killing the mammal, the county finally resorted to dynamiting it.

**64-0265**
Davies, A. G. Refuse disposal--problem and task of our time. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962. p.1-24.

The indiscrimate dumping of refuse must cease, for it bears no thought to problems of water pollution, vermin breeding or general nuisance. Harnessed to mechanical power, it can enable the recovery and utilization of land. Unless scientists offer radical opportunities for change, it seems that incineration, pulverising and composting are the available alternatives for ultimate disposal. There is a need for research and development with funds from the national level in each country, in order that experimental work can be undertaken to the best advantage. The circumstances must be created whereby it becomes possible to adopt the most efficient and appropriate method of disposal in each case, with finance forming a supplementary factor rather than a primary one. Although there are signs of changing tendencies, the cheapest approach to an individual problem is not always the best.

**64-0266**
D.C. officials seek new disposal sites. Refuse Removal Journal, 7(2):34, Feb. 1964.

The nation's Capital is running out of disposal sites for the ash residue that is generated by its four incinerators. The city's one sanitary landfill is expected to be used up within another year. Modern packaging techniques receive the blame for the ever-growing load of waste. No one has yet come up with a solution.

**64-0267**

Des Rosiers, P. E. Investigation of low-cost sanitation systems; branch report. Fort Belvoir, Va., U.S. Army Engineer Research and Development Laboratories, Nov. 19, 1962. 77 p.

An extensive survey was made of the literature on sanitation systems applicable to the treatment of human wastes in fallout shelters. Preliminary Laboratory tests of various chemical agents were conducted to determine effectiveness for control of objectional odors and to measure the bacteriocidal and bacteriostatic properties of the chemical agents. Conclusions are that the sanitary vault concept has inherent advantages that should be evaluated under realistic fallout shelter conditions in order to determine optimum design and acceptability features. The masking of odors is considered to be a poor method of odor control. A minimum air recirculation rate of 2 cu ft per min in the privy tested is effective in controlling the level of odor. Chemical treatment of human wastes collected in open containers can effectively suppress odors. Three combinations of readily available and relatively inexpensive chemicals found effective were: cupric sulfate, sodium bisulfate, and mineral oil; saponified cresylic acids and mineral oil; and boric acid, sodium perborate, and mineral oil. The dual purpose container, with proper chemical treatment of waste, can serve as a suitable means for collecting and storing of human excreta over a period of at least seven days.

**64-0268**

Des Rosiers, P. E. Evaluation of human waste disposal systems. In Investigation of low-cost sanitation systems; branch report. Fort Belvoir, Va., U.S. Army Engineer Research and Development Laboratories, Nov. 19, 1962. p.1-36.

It is the objective of this study to evaluate technically human waste disposal methods, known or as yet unconceived, for possible use in fallout shelters. The essential characteristics of such a unit are: acceptance of any wastes without subsequent handling; a safety factor for over-crowding and modular desing. Applicability of standard sewage disposal methods to fallout shelters, biological decomposition, gas production in sewage digestion, and currently available household sewage treatment devices are reviewed. Approaches to the problem are: individual disposal bag method; maceration, or a sanitary vault. Disposal of human excrement in individual soft-plastic or rubber containers, tightly sealed and deposited into a common receptacle, should be considered. The container would be a non-permeable bag attached to a toilet seat. Excreta can be treated in a manner that is acceptable if it is mechanically reduced to a size where disinfectants can come in intimate contact with it, and the liquid is separated from the solid waste and eventually treated for possible reuse. The sanitary vault would be a single valut or receptacle which would initially contain a supply of disinfecting and odor control chemicals designed to receive all wastes. Of considerable value is the fact that a sanitary vault will function effectively without electric power, mechanical parts, or running water.

**64-0269**

Des Rosiers, P. E. Investigation of chemical odor control methods for treatment of human wastes. In Investigation of low-cost sanitation systems; branch report. Fort Belvoir, Va., U.S. Army Engineer Research and Development Laboratories, Nov. 19, 1962. p.27-70

It is the objective of this study to evaluate effective chemical sanitizing methods for use in treating and deodorizing human wastes in the confined environment of fallout shelters. Effective sanitizing methods for the treatment and deodorizing of human wastes must be primarily concerned with either bacteriostatic or bacteriocidal measures. A laboratory screening test was devised to initially select agents which would be effective in deodorizing and treatment of wastes. Those agents selected were: hydrated lime, hydrated lime and charcoal, mixed cresylic acids, and borax. They were then subjected to privy studies. Results showed that three combinations of readily available and relatively inexpensive chemicals are effective in suppressing odors in an open container which is used as a receptacle for human excreta. Any one of the chemical combinations, $CuSO_4$, $NaHSO_4$, mineral oil; $CuSO_4$, $NaHSO_4$, mineral oil, cresylic acids; boric acid, sodium perborate, mineral oil; and saponified cresylic acids, mineral oil, will reduce odor to a level which is not objectionable. If the count of viable organisms is used as a criterion for evaluation, the greater effectiveness of cupric sulfate and sodium bisulfate is unquestioned. From the data accumulated, with odor suppression and bacteriocidal action both considered, this combination of chemicals would be preferred.

**64-0270**

Disposal of waste oil, tires and building materials surveyed. APWA [American Public Works Association] Reporter, 31(1):20-21 Jan. 1964.

This article presents the results of a survey of 38 cities, population over 100,000, in relation to disposal of waste oil, tires, and building material. There are two tables which list the cities using private disposal methods and/or public disposal methods. Of those cities where the materials are disposed privately, waste oil is most commonly reclaimed, waste tires are disposed in landfills or dumps, and building materials are disposed of in landfills. Of the 26 cities that assume disposal responsibilities, 8 use landfills to dispose of waste tires, and 17 use landfills for disposal of building material. Most cities are satisfied with their disposal methods. While current regulations and disposal practices have eliminated air and water pollution problems in 24 cities, only a small portion have specific regulations for disposal of waste oil, tires, and building materials.

**64-0271**

Disposal of wastes in South Australia. Good Health for South Australia, 126, 10-13, Oct. 1964.

Methods of refuse disposal in South Australia are: a) controlled tipping; b) dumping and burning; and c) disposal into the sea. The most practical and cheapest method is controlled tipping. The reclamation of land is shown in Marion, where a soccer field has been developed over a tipped area. A proposal to assist in the disposal problem is to use the tidal swamp in Port Adelaide-Salisbury area where thousands of acres of mosquito breeding swampland are available, and could be converted into useful recreation areas. Controlled tipping should be the main method used, with a large modern destructor for the disposal of burnable refuse.

**64-0272**

Disposal system. Modern Sanitation and Building Maintenance, 16(8):33, Aug. 1964.

The Auto-pak eliminates the need for separate incinerator stack and destructor room. As trash is placed into a refuse hopper, an electric eye activates the system's hydraulic packing mechanism. Refuse falls to the bottom. The packing ram moves forward with a force of 40,000 lb, compacting refuse to less than 25 percent of original volume.

**64-0273**

Donaldson, E. C. Disposal wells. In Subsurface disposal of industrial wastes in the United States. U.S. Bureau of Mines Information Circular No. 8212. [Washington], U.S. Department of the Interior, 1964. p.6-8.

Where the manufacturing process is dependent upon inunterrupted operation of a waste-disposal well, some companies have provided a standby well. The waste stream is split either by separate injection pumps or by valves from a common manifold. Sometimes monitor wells are pumped and sampled once a month to test the quality of water from the lowest fresh water aquifer. For the average chemical waste disposal well, a 15 in. diameter hole is drilled about 200 ft below the deepest fresh water aquifer, where ten ¾-in. OD casing is set and cemented to the surface. A cased-hole or open-hole completion method can be used. Unconsolidated sand formations may be gravel-packed to prevent sand cavings from filling the bottom section of the injection casing and thus restricting the outward flow of fluids. Disposal wells are equipped with tubing when corrosive waste is to be injected. Tubing that is internally coated with plastic or cement commonly is used. When the well is completed, drilling mud is washed from the face of the formation by pumping water into the tubing and allowing it to circulate to the surface through the annulus between the tubing and the casing. Acidizing and hydraulic fracturing of the formation are used to increase the injectivity of newly completed wells and to stimulate old wells that have become plugged with suspended solids.

**64-0274**
Donaldson, E. C. Surface equipment used in waste disposal. In Subsurface disposal of industrial wastes in the United States. U.S. Bureau of Mines Information Circular No. 8212. [Washington], U.S. Department of the Interior, 1964. p.2-6.

The essential units of a typical system for subsurface disposal of waste consist of sump, separator, clarifier, filter, chemical treater, surge tank, and pump. The amount and type of equipment necessary to prepare a waste mixture for injection depends upon the amount and size of suspended solids in the waste, the pure size of the formation matrix, the chemical compatibility of the waste and formation water, and the corrosiveness of the waste. The removal of suspended solids is unnecessary where the disposal formation is limestone or dolomite containing interconnected vugs and fractures. A cement sump tank or a 30,000 to 50,000 gal steel tank provides storage for collecting and mixing waste streams. Large, shallow, open ponds provide sufficient detention time to permit natural sedimentation of particulate matter from the waste during passage from the inlet to the outlet. The ponds are commonly equipped with aerators to oxidize iron and manganese salts to insoluble forms that precipitate in the agitation pond. Aqueous chemical wastes usually contain large amounts of particulate matter such as polymeric flocs, dirt, oil, and grease that can plug the disposal formation. The sedimentation process can be accelerated by adding a flocculating agent. Dual filtration is used to condition waste for disposal into sandstone formations with small pore sizes. When the waste contains microorganisms, a small amount of a suitable bactericide is added.

**64-0275**
Dove, L. A. The area-wide approach to refuse disposal. In Solid waste disposal and municipal equipment 'rental'. New York, Buttenheim Publishing Corporation, June 1963. p.51-56.

A regional or area-wide approach to refuse disposal is in keeping with the trend toward metropolitanization that is evolving in most urban areas. A new level of area-wide self government or a regional planning agency empowered to make decisions of importance to the total urban community is necessary. Some of the legislative acts and policy measures that a regional body should consider with regard to area-wide refuse disposal include: taking immediate action to ban the open dump; adopting minimum standards for refuse disposal operations over the entire region; adopting a comprehensive area-wide ordinance to regulate and control the disposal and dumping of refuse; consideration of controlling rates at disposal sites or effectively districting the total region under study; and preserving certain sites with optimum characteristics for refuse disposal for future needs. Factors such as the most favorable soil conditions to minimize water pollution, meteorological conditions, and the over-all effect on the transportation network should be given full consideration in site selection. The kaleidescopic pattern of financing refuse collection and disposal in any given area makes it impractical to generalize on solutions to this problem.

**64-0276**
An editorial. Refuse Removal Journal, 7(3):14, Mar. 1964.

In many areas the so-called shortage of disposal sites is an artificial one created by the opposition of the uninformed public. An educational program to enlighten the public about the many problems related to refuse collection and disposal is needed. Such a program should be sponsored by the National Council, supported by the entire Sanitation Industry, and developed and carried out by experts in public communications.

**64-0277**
An editorial. Refuse Removal Journal, 7(8):14, Aug. 1964.

The shortage of disposal sites is discussed. In the future there may be 'disintegrating plants' that will turn refuse into gas which will vanish into the atmosphere or space-penetrating missiles which will transform the universe into a giant disposal facility. Now, however, perhaps the key is the development of a really workable method of composting. Hopeful signs in this direction are plans by Westinghouse to build compost plants and the Solid Waste Disposal Act of 1964 currently before Congress.

**64-0278**
Eldredge, R. W., and H. J. Dominick. 1963-1964 Refuse disposal study: Winnebago County, Illinois. 1964. 39 p.

Winnebago County, Illinois, is about 91 miles northwest of Chicago. Rockford, the county seat, is an industrial city employing most of the residents of the County who are employed in manufacturing activities. By 1970 the population of the County may be about 300,000 with Rockford having about 200,000. The problem of refuse disposal is compounded not only by the rapid increase in household units but also by the increasing amounts of refuse generated by each unit. The present study describes the methods of refuse disposal, gives a brief history of Rockford's disposal facilities in the County, and investigates possible ground water pollution by sanitary landfills. Conclusions and recommendations are given in the Introduction.

**64-0279**
Emanuel, C. F. Waste disposal in space vessels. Journal of the Water Pollution Control Federation, 36(10):1229-1239, Oct. 1964.

In the aerobic degradation of combined feces and urine, there is one resistant fraction which is brown and called 'hestianic acid'. It possesses a complex and heterogeneous structure, is strongly acidic, and has an inability to dialyze. The acid was found to be either poly-disperse or quite impure and contains neither protein nor polysaccharide. Spectrographic analysis indicated the presence of nitrogen and carboxyl groups. Hestianic acid did not appear to arise from bile and blood substances. The ubiquitous melanines are suspected of being the source of hestianic acid because of structural and chemical composition similarities. Because of the resistance of this pigment to biological degradation, the problem of freeing the reactor from this refractory material will require special consideration. The alkaline permanganate degradation, hydrolytic degradation with sulfuric acid, tryptic hydrolysis, perchloric acid hydrolysis, dichromate oxidation, and hydrolytic reduction with zinc and hydrochloric acid analytical processes were employed to obtain results in this paper. Additional data and tables are contained within this paper to support the conclusions given.

**64-0280**
Examination of refuse samples. Technische Ueberwachung, 5(4):141, Apr. 1964.

A movable outfit for the examination of refuse samples was procured by the Research and Development Institute in Stuttgart. With this equipment, it is possible to obtain the necessary data to make appropriate recommendations for the removal or use of the different kinds of refuse, which in the course of a year are recorded in the books of the Association for Communal Transport. Comparisons are made of the various methods, such as deposition in the raw or prepared stage, incineration, composting, and removal in conjunction with liquid waste. The equipment consists of a filtering device, which divides the refuse into three particle sizes, a grinder for pulverizing, portable containers for samples to 500 kg, a conveyor belt, a spring balance and sets of pulleys. The chemical, physical and biological analysis takes place in the laboratories of the Institute in Stuttgart. (Text-German)

**64-0281**
Faith, W. L. Air pollution research--reflections and projection. Journal of the Air Pollution Control Association, 14(9):367-369, 371, Sept. 1964.

In this general review of past, present, and future of problem-oriented research in air pollution, solid waste disposal is presented as one of the areas where engineering research can have a real impact on air pollution control. The methods of solid waste disposal practiced at the present time include: uncontrolled open burning (as in municipal dumps); controlled open burning (weed control programs); incineration; sanitary landfill; and composting. The most widely used, uncontrolled open burning, is the most obnoxious from the air pollution viewpoint. In spite of its intolerable aspects, the other disposal methods also have their problems and the town dump continues to pollute the air. The Taft Sanitary Engineering Center has conducted some excellent research on incineration, but much is unknown about all forms of solid waste disposal. The need for greater research expenditures in the study of the disposal of solid waste is apparent when it is realized that the daily production of solid waste on a dry basis is three times that of the weight of our sewage. In this review and prediction article, solid waste disposal is considered as one phase of air pollution research. The conclusions in regard to air pollution apply also to solid waste disposal. There is more money at the present than capable manpower, and the funds are outrunning good ideas. The chief source of funds for air pollution research (and solid waste disposal) will be the U.S. Public Health Service which will underwrite most of the air pollution work in universities and, to a lesser extent, at the state environmental level.

**64-0282**
Faust, S. D., and M. C. Manger. Electromobility values of particulate matter in domestic wastewater. Water and Sewage Works, 111(2):73-75, Feb. 1964.

Information on the quantitative electromobility values of particulate matter in domestic wastewater would be useful in the evaluation of the electrochemical phenomena involved in the removal of waste substances by various chemical and biological treatment processes. A study was therefore done to determine the sign of particle charge and the magnitude and distribution of electromobility values of particulate matter in a typical domestic wastewater. Electromobility values were determined by the Briggs cell technique. It was found that the particles are negatively charged and have electromobility values ranging of -0.55 to -3.75 mu per sec per v per cm for 707 observations. Specific conductance, pH, and instantaneous wastewater flow influenced the distribution of the electromobility values about a normal probability curve. A normal distribution about an average value is to be expected because of the heterogeneous chemical composition of the supracolloidal and colloidal fractions of domestic sewage and indicates that the association of counterions with the various particles is governed by probability within the well-defined laws of electroneutrality.

**64-0283**
Feitchinger, C. Needed: more facts on waste disposal. Nation's Cities, 2(9):24-26, Oct. 1964.

As the problems of solid waste disposal grow more difficult and expensive to solve because of the growth of the urban population and more rigid requirements of land, air, and water pollution control, it appears that more basic and applied research is necessary on solid waste disposal to provide the decision makers with necessary facts to replace the trial and error methods being applied now. Efforts of the town of Irondequoit, New York, with a population of 60,000 and very little industry to solve their waste disposal problem are discussed. The advantages and disadvantages of sanitary landfill at the low cost of $1.25 per ton, incineration at $6.00 per ton and composting at $3.25 per ton were reviewed. Land-fill was eliminated due to lack of space. Cost, air pollution, and equipment obsolescence were the disadvantages of incineration that led to an interest in composting. A study was made of the NORCO process in Jamaica and a proposal was received from NORCO to build a composting facility and charge the community $3.25 per ton for handling the refuse and guarantee the effectiveness of the process and the absence of odor, smoke, noise, or attraction of insects and rodents. Public interest and support is lacking, as is a definitive third party objective study of the alternatives. Such a study would be a legitimate role for the federal government by providing disinterested data for the formulation of public policy.

**64-0284**
Ferber, M. The waste problem is a planning problem. Brennstoff-Waerme-Kraft, 16(8):373-375, Aug. 1964.

Facts and conditions which must be considered by the community in formulating plans for organization of disposal of waste are discussed. All planning starts with an estimate on the amount of waste expected and the cost of its collection. This will determine the location and number of the waste treating facilities. The different methods for waste treatment are discussed and the advantages and disadvantages of each are presented. In certain cases, a combination of methods like incineration and composting could be employed. Finally, it is suggested that possibilities should be more thoroughly investigated to reduce the amount of waste produced by industry and households. Foundry sand and packing material are cited as examples. (Text-German)

**64-0285**
Forester, D. F. Problems of bulk in refuse--'output'. Presented at Meeting of the Institute of Public Cleansing, Dundee, Scotland, Apr. 8, 1964.

Analyses of domestic refuse from the City of Glasgow are given and corresponding tables are included. Data indicates the tendency over a 15-year period to employ forms of heating other than solid fuel, thus lowering the percentage of dust and cinder content in refuse. If this trend continues, the already increasing paper content will rise still further. In addition, the introduction of 'smokeless zones' by the government's Clean Air Act has increased trade refuse commitments. There is no great variation between 1947 and 1963 in bone, vegetable, and putrescible content of refuse. If the percentage should increase, however, the most economical methods of disposal would have to be reconsidered. An increase of 40 percent since 1947 in metal content implies needed consideration for most efficient means of its disposal, also. However, the most significant change is in the amount of paper content, which has increased from 5 percent to 22 percent, disregarding paper and cardboard collected separately for salvage. Three and a half million tons of paper and board were consumed in Scotland in 1939, while at present this amount equals some 5 million tons. Assuming a density of 1 to 1¼ cwts per cu yd, this data implies numerous problems of bulk in refuse and its disposal.

**64-0286**
Frechen, B. 1963 Meeting of the Association for Waste Water Technology, North Rhine-Westphalia regional section. Wasser und Abwasser, 105(8):211-212, Feb. 1964.

The tenth annual meeting of the North Rhine-Westphalia regional section Association for Waste Water Technology was held in Bochum on Nov. 15, 1963. Five lectures presented there are briefly reviewed. Their titles are: ''Urban problems in Bochum''; ''Measures for tank and tank truck accidents''; ''Accident prevention in sewage systems''; and ''Trash and sewage sludge''. Combined elimination of trash and sludge by incineration and by composting was discussed. It was pointed out that the sludge need be concentrated only to a water content of 90 percent for economic incineration. For a city with a population of 100,000, the daily costs for the elimination of sludge is 500 DM as compared with 350 to 400 DM for combined composting. The last lecture, ''Clean water maintenance'', dealt with new waste water purification plants in the Ruhr-Lippe area. (Text-German)

**64-0287**
Freund, A. W., and C. J. Altenburg. Report on waste disposal system. Mohole Project for Brown & Root, Inc., Machinery. Study No. M-46. New York, Gibbs & Cox, Inc., Sept. 1964. 29 p.

This report presents the results of a study for the disposal of all burnable rubbish. When considering all the facts, including maintenance and operation of equipment, manning to operate the equipment, fire hazards involved, housekeeping, weight, and cost, a baling machine is recommended. The baling machine would be installed and all bales of rubbish would be disposed of ashore or at a distant point at sea via the supply vessel. If an incinerator is desired, then the capacity of this unit should be about 120 lb per hr. The 75 lb per hr capacity incinerator initially selected is considered to be too small to meet the recommendations, and the installation of an incinerator will increase topside weight in the range from about 6,375 lb to 11,500 lb. The use of a baling machine appears to be better, but storage problems for the bales and handling problems associated with the space for unloading for the bales onto the supply vessel must also be considered.

**64-0288**
Freund, A. W., and C. J. Altenburg. Types and classification of wastes and incinerators. Incinerator capacity. In Report on waste disposal system. Mohole Project for Brown & Root, Inc., Machinery. Study No. M-46. New York, Gibbs & Cox Inc., Sept. 1964. p.3-12.

The Incinerator Institute of America has assigned type numbers to waste materials depending upon their source and composition and has classified incinerators by types, burning rate, and type of waste to be burned. Some of these classifications are presented. Differences in operation and spark arresting devices on the Navy shipboard type and commerical incinerators are described. The amount of rubbish is estimated at approximately 920 lb per day. An 8 hr operation is considered most practical for marine watch standards and on this basis the incinerator capacity is estimated at 115 lb per hr.

**64-0289**
Freund, A. W., and C. J. Altenburg. Alternated method for disposal of rubbish. Weight

comparison. In Report on waste disposal system. Mohole Project for Brown & Root, Inc., Machinery. Study No. M-46. New York, Gibbs & Cox, Inc., Sept. 1964. p.18-22.

Since it is not desirable to dispose of all rubbish and other burnable waste materials by dumping in the sea, it appears that the next best, lightest in weight, and least costly method of disposal is by baling and disposal of the bales ashore or at a distant point at sea via the supply vessels. A handpowered baler is described. A room set aside for the storage of the waste bales must be provided. The size, weight, and number of bales to be handled is given. A table is presented to indicate a comparison of top side weights for various size incinerators and baling machines.

**64-0290**

Geldreich, E. E., H. F. Clark, and C. B. Huff. A study of pollution indicators in a waste stabilization pond. Journal of the Water Pollution Control Federation, 36(11):1372-1379, Nov. 1964.

Waste stabilization ponds represent an economical method of waste disposal, largely due to reported high coliform removals. Bacteria such as coliform indicate pollution removal. Studies of the effectiveness of fecal coliform and streptococcous groups as indicators were made on a prison dairy farm. Characteristics looked for were: constant occurrence in human feces; consistent presence in sewage and polluted waters; and ability for accurate enumeration. Raw sewage employed was composed of domestic and laundry wastes. Relative densities of bacterial indicators were determined for four seasonal periods of the year. Raw sewage coliform densities per 100 ml were 3.2, 3.3, 3.3, and 2.4 million during spring, summer, autumn, and winter respectively. Fecal coliform levels ranged between 790,000 and 920,000 per 100 ml during spring, summer, and winter, but inexplicably jumped to 2.65 ml in autumn. Fecal streptococcal densities varied from 2.1 to 4.1 million. These densities must be qualified because the pond was used in dairy operations. The pond caused total coliform population reductions from a minimum of 85.9 percent to a maximum of 94.4 percent. Fecal coliform reductions were between 87.9 percent and 98.3 percent, fecal streptococcal from 97 percent to 99.8 percent. S. bovis, absent from workers' feces, appears to be an excellent indicator of non-human animal pollution. The possibility of securing false positive reactions from organisms associated with soil was demonstrated. For this reason, fecal coliform and streptococcus tests yield more valuable information than total coliform alone. Included data show information such as identification schemes and bacterial discharges, reductions, and distributions.

**64-0291**

Getting rid of solid wastes. Good Health for South Australia, 126:7-9, 26, July 1964.

Open dumps and controlled tipping are discussed. Burning in open dumps causes air pollution problems, unpleasant odors, and an increasing volume of complaints of nuisance. It is important to set controlled tipping areas away from water sources to prevent pollution. High accident and sickness rates of the Department of Sanitation of New York City, and the series of tests an applicant must complete are reported. These include a rigorous physical fitness test. Even though these applicants pass the fitness tests, there is an unfavorable comparison with those of the policemen, firemen, and stevedores in the same city.

**64-0292**

Good neighborliness. Public Cleansing, 54(2):731, Feb. 1964.

The advantages of regional disposal of refuse in England whereby many communities share the same dump under one authority are discussed. The County Planning Department of Lancashire is among the front runners in regional disposal, for it requested the scheduling of nearly 2,000 acres for this purpose. Good neighborliness should be the guiding principle in setting up such disposal.

**64-0293**

Good on waste, bad on dogs. Public Cleansing, 54(12):1334, Dec. 1964.

According to the annual cleansing report of Burnley, Scotland, salvaging is successful. Refuse should be pulverized or composted before tipped because of the changing nature of refuse. The cleansing and transport superintendent of Burnley is dissatisfied with the citizens' lack of concern regarding a good public cleansing system.

**64-0294**
Goode, C. S. San Diego disposal plan provides for a 20-year population increase. Refuse Removal Journal, 7(12):18, Dec. 1964.

San Diego County has developed a refuse disposal plan which will form the basis of planning for the next 20 years. The plan calls for operation of 22 refuse disposal sites by the county and three by the City of San Diego to accommodate the present 1.2 million population and ultimately twice that number. The majority of the disposal sites now are controlled burning dumps. The great number of canyons make the terrain ideal for sanitary landfill sites. Completed and planned conversions of landfill sites into usable land are described. Communities must develop master plans for refuse disposal sites--with imagination and foresight. Research into guides for constructing buildings over sanitary landfills is also necessary.

**64-0295**
Gordon, M. The city dump. In Sick cities. New York, Macmillan, 1964. p.229-248.

Boston is given as an example of the problem of solid waste disposal in an urban situation. For 27 years (1922-1959) Boston dumped 25 percent of its refuse on Speciacle Island, which is 2 miles offshore in Boston Bay and contains 50 acres. The rubbish became so high (35 to 45 feet) that it became uneconomical to pile it higher. In 1959 an incinerator was put into operation. It was capable of burning 900 tons of refuse daily, which was 60 percent of all the rubbish Boston was then producing. Across America the problem of disposal is becoming common and acute. Dump sites are scarce and arouse neighborhood antagonism. Refuse itself is increasing: there are more people and each generates more refuse. The average person produces almost 3½ lb per day compared with 2 lb per day 20 years ago. Even cities with decreasing population have an increasing disposal problem: Washington, D.C.'s population declined from 802,000 in 1950 to 764,000 in 1960 but its refuse increased from 2.7 million to 3.5 million cu yd. The dump, the sanitary landfill, the problems of the small governmental unit (the county in which Pittsburgh is located has only three times Pittsburgh's population but 129 separate government units), the hog as a consumer of man's waste, the declining use of the ocean as a receptacle, the problems of collection and haulage, household garbage grinders, and composting are all discussed in this survey. The experience of certain cities and countries in dealing with these problems is cited.

**64-0296**
[illegible]leaf, J. W., and B. A. McAdams. Designing an ocean outfall for North Miami Beach. Journal of the Water Pollution Control Federation, 36(9):1107-1115, Sept. 1964.

Four plans for treatment plants and three points of disposal for the City of North Miami Beach, Florida are outlined. The first of these plans (Plan A) would be to discharge a highly-treated sewage effluent into the Intracoastal Waterway near the Sunny Isles Causeway. Plan B involved the continuous discharge of treated sewage effluent into Biscayne Bay at Baker's Haulover Cut. Since the dilution factor is so great here, the sewage effluent would be disinfected to a somewhat lesser degree than that at Sunny Isles. The third plan (Plan C) involved the discharge of sewage, which had undergone only primary sedimentation into Biscayne Bay at Baker's Haulover Cut on the outgoing tide. The final plan (Plan D) considered discharge to the Atlantic Ocean through a submarine outfall. Chloride, pollution, float, bacterial die-out, and dilution tests were run on the Miami Beach outfall. Upon the conclusion of studies, all tests proved favorable to Plan D. Data and illustrations give the results of tests performed.

**64-0297**
Halmos, E. E. Missile base water and waste facilities. Water and Sewage Works, 3(4):176-179, Apr. 1964.

Sewage disposal for Merritt Island, Florida, will be surprisingly simple despite the location and nature of the community. The 66,000 acre community will be the site of the final drive in the U.S. race to the moon, and will have a daily population of about 10,000 persons. Although the area is nowhere more than 7 ft above groundwater, no problem of contaminating local underground supplies is expected to arise. First, all water for drinking and process use will be piped from 25 miles away, and secondly, little handling of contaminating chemicals is to be done on the site. In addition, wastes from more normal industrial processes are handled by individual septic systems. A concrete-walled, activated sludge treatment plant is designed to provide primary and secondary treatment for a capacity of

310,000 gpd. Three lift stations, each equipped with injector-type pumps, serve the 63 by 100 ft one-story plant. The water supply, piped from Cocoa, Florida, must serve not only normal sanitary purposes, but industrial process and a closed hot-water heat system as well. Pipes are set about 7 ft below ground surface.

**64-0298**
Importance of research into refuse disposal. Surveyor and Municipal Engineer, 124(3770):64-65, Sept. 5, 1964.

The importance of refuse disposal and the lack of data and research upon which to base control work are emphasized. The interest of the Federal government in the United States in solid waste disposal is given as an example as to what should be done in Britain. It was indicated that in the United States financial and technical support was given to programs of solid waste disposal research on a nation-wide basis including the erection, maintenance, and operation of pilot plants for composting, incineration, grinding, disposal to sewers and salvage. Controlled dumping for land recovery is also being investigated. It is urged that in Britain the research into the numerous unsolved problems should be government sponsored and financial support be given to municipalities to erect pilot plants. Some of the problems worthy of investigation include: a determination of the temperatures required to kill pathogens in material being dumped; and the question as to whether the temperatures required to kill pathogens in sludge will kill the useful components of the compost. The need for research into operational efficiency and economy is obvious.

**64-0299**
Improved conditions and lower costs in refuse disposal. Surveyor and Municipal Engineer, 123(3751):59-60, Apr. 24, 1964.

The new Hove refuse disposal and salvage plant is described. In the new plant the tailings, after the removal of two-thirds of the total weight as salvage, are incinerated. The operation results in better working conditions and increased salvage income. Out of a weekly 316 tons of salvage material, there were 4.5 tons of bottles, 45 tons of paper, 18 tons of cans, and 4.5 tons of rags. Magnetic separators before and after screening give the maximum recovery of ferrous material (9 tons a week). The new plant is the answer to the lack of dumping area in Hove.

**64-0300**
Jacobson, A. R. Home waste disposal in Alaska. Public Works, 96(3)140, Mar. 1963.

A waste disposal system incorporating a marine toilet, chlorinator, hand pump and storage tank was constructed and evaluated by the Environmental Sanitation Section, Arctic Health Research Center, Anchorage, Alaska. The aim of the project was to provide a satisfactory indoor toilet unit not requiring a constant supply of water or electric power for operation. The two units tested operated by recirculating the flushing water, thereby eliminating the need for a water source, and used a hand-operated pump which eliminated the need for power. The system proved acceptable when tested by a two-member household over a 6-month period, but was not aesthetically acceptable to one member of a second household. It is designed to save on the use of potable water, the very small amount of effluent (1 qt per day per person) virtually eliminating the usual problem of disposing of the large quantities of liquid wastes from toilets. However, the problem of final disposal of the tank contents has not been entirely solved.

**64-0301**
Jensen, H. P. Problem facing industry today. Refuse Removal Journal, 7(9):46, Sept. 1964.

Problems currently facing the sanitation industry are discussed. The use of disposal sites is a major cost factor, increasing 240 percent since 1955. State licenses are also costly. A number of municipalities such as Waukegan and Rockford, Illinois; Boston, Massachusetts; and Oak Park, Michigan, have largely solved their problems by turning to private enterprise. Toronto, Canada, is an example of a city that has benefited from the use of sanitary landfills. What is now needed is research into solid waste disposal, including methods of making solid wastes usable, and public awareness that sanitary landfill sites need not be nuisances. Typical provisions in municipal ordinances as a guide to local officials are given. Garbage, rubbish, mixed refuse, ashes, bulk refuse, dead animals, hazardous refuse, household waste, institutional waste, commercial waste, industrial waste, building waste, a licensed waste collector, and building debris definitions are given.

**64-0302**
Johnson, R. L., F. J. Lowes, R. M. Smith, et al. Evaluation of the use of activated carbons and chemical regenerants in treatment of waste water. U.S. Public Health Service, May 1964. 48 p.

The capacities of six activated carbons for the soluble organics in filtered secondary effluent were obtained by use of a continuous flow, column-type test. Results varied from 7 to 13 g COD per 100 g of carbon. Because of the manner in which the test was carried out, only the carbon with the smallest capacity was loaded to the maximum extent possible. The chemical regeneration of exhausted carbon was investigated by use of nine inorganic oxidizing agents. Only hydrogen peroxide was capable of restoring measurable adsorption capacity after more than two cycles of exhaustion and regeneration. The economic feasibility of chemical regeneration is not promising. The report includes explanatory tables and figures.

**64-0303**
Joyce, R. S., and V. A. Sukenik. Feasibility of granular, activated-carbon adsorption for waste-water renovation. AWTR-10. U.S. Public Health Service, May 1964. 32 p.

Granular, activated carbon in packed-bed column contactors was shown to remove much of the organic matter including alkylbenzenesulfonate from municipal waste water. The COD of a secondary effluent was reduced to about 12 to 20 ppm and the ABS was removed almost entirely. When an ABS breakthrough concentration of 0.5 ppm is used as a criterion of carbon exhaustion, the amount of carbon required for countercurrent contacting is less than 1 lb per 1,000 gal. For the process to be economical the carbon must be reactivated and re-used. Thermal reactivation in a steam-air atmosphere was found to be technically feasible. With reactivation, the total cost of carbon adsorption was estimated to be less than 10 cents per 1,000 gal for plants treating 10 mgd of waste water. The report includes explanatory figures and tables.

**64-0304**
Kampschulte, J. Waste utilization. VDI (Verein Deutscher Ingenieure) Zeitshcrift, 106(14):603-617, May 1964.

The various ways of eliminating waste employed in countries of Western Europe are discussed. A backward trend can be observed in the sorting out of junk from waste material, with the exception of magnetic removal of metal. Composting plants, however, are on the rise. The Netherlands have 15 composting plants and a new one is in the planning stage. A new composting-incineration plant in Bucchs, Switzerland, has been taken into operation. Pictures of this new plant and a detailed description are given. Near Zurich and near Geneva, waste-sludge composting plants have been built. Composting plants in Switzerland, England, France, Sweden, and Germany are discussed. The cities of Manchester and Twickenham plan to build composting plants with capacities of 250 tons per day and 40 tons per day. In East Germany, the natural composting method is used, which is explained in some detail. A waste-sludge composting plant is in operation in Schweinfurt, West Germany, where sludge and waste are mixed and compacted into cubes for rotting. In Heidelberg, compost is produced in a rotting tower according to the multibacto method. New waste incinerator plants are being erected all over Europe. All the larger and more important plants are described in detail and illustrations are given. Most exhaustively treated are the new plants in West Germany, but others (in Austria, Italy, Netherlands, Switzerland, England, Denmark, and Sweden) are also discussed, with illustrations and cross-section diagrams. (Text-German)

**64-0305**
Lane, J. M. An over-all engineering evaluation. In Solid waste disposal and municipal equipment 'rental' . New York, Buttenheim Publishing Corporation, June 1963. p.40-45.

One of the first steps toward a solution of the solid waste problem is to determine the quantity of wastes which must be disposed of. Weighing the refuse over a period of time provides the best method. To determine the feasibility of the various disposal methods some knowledge of the characteristics of the wastes must be known but the published data on their physical and chemical composition is meager. To determine whether the disposal facilities will be adequate to serve the community in the future, their characteristics and the trends in production must be studied. Even though the open dump has been accused and found guilty, it is still used by many as a means of disposal. Hog feeding is still in use in many areas. Its economics depend upon the conditions of the hog market and the length of haul to the hog farm. The major advantage of sanitary landfill is its low first and operational cost. The sanitary landfill method is most attractive to the small community with a limited budget and submarginal land within a short hauling distance. One disadvantage of the sanitary landfill is that its capacity is limited and when it is exhausted officials must find another site of adopt another disposal method.

**64-0306**
Lane, J. M. An over-all engineering evaluation. In Solid waste disposal and municipal equipment 'rental'. New York, Buttenheim Publishing Corporation, June 1963. p.46-50

High-temperature incineration, as practiced today, provides a means for the disposal of refuse without creating nuisances. Properly engineered, an incineration plant will answer the needs of a community for the foreseeable future. It reduces the refuse to inert gases discharged to the atmosphere and an inert, inoffensive, easily compacted ash well suited for landfill. Only 20 to 25 percent of the waste materials by weight remains as ash. The reduction in their volume is even greater. Some are able to apply the heat content from combustion for useful purposes. The site requirement for a incinerator is much smaller than for a sanitary landfill and its location is not nearly as restricted. Combustion computations depend on the moisture content, heat value, and ultimate analysis of the fuel. Engineers have long realized the desirability and economical advantage of the joint disposal of refuse and sewage solids. More than 20 years' experience in burning sludge solids has shown one of the most important requirements for success is that of constant agitation. The utilization of the heat content of the refuse gas to evaporate the free moisture from the sludge solids and support their combustion has proved to be the most successful joint disposal method to date.

**64-0307**
Lawson, S. P. Economic and sanitary disposal of waste from small communities. Water and Waste Treatment, 9(12):584-588, Mar.-Apr. 1964.

The problem of how a small community shall treat its wastes to the maximum advantage of the community is discussed. The discussion includes an illustration of the dynamic F/M (food to microorganism) ratio in order to emphasize that the design of a waste plant is not only a problem in hydraulics and structural design. The solution proposed for the treatment of unreticulated small community wastes is the application of fundamental metabolic studies to a general case. There is a need for fundamental basic research and for biologically trained engineers who can assess the practical applications of these basic studies. It is emphasized that the smaller community, being closer to the land, is interested in the reconditioning of waste as a product for reuse and the maximum use is made of sludge and anaerobic decomposition. The idea is advanced that water-borne sewerage is one of the basic causes of food shortage in the world. Sketches are given of treatment plants suitable for small communities. The smaller the community, the greater the need for qualified advice and the less the need for packaged units based on claims rather than an objective bioengineering approach.

**64-0308**
Ledbetter, J. O. Air pollution from aerobic waste treatment. Water and Sewage Works, 111(1):62-63, Jan. 1964.

Aerosols, given off through aerobic waste treatment, are air suspensions of particulates which may emerge as droplets. The droplets evaporate, leaving the nuclei of solid wastes. Waste treatment plant odors originate in influent from sewers, deposits of grit and grease, stabilization, and anaerobic conditions. Methyl mercaptans, methyl sulfides, and amines plus indoles and skatoles have been cited as the most common offenders. Aerosols may be attenuated by covering the surface with a permeable plastic film that permits passage of air but not water, using a spray of harmless water to knock down the aerosols, or collecting the aerosol above the unit and removing particulates. Combustion, adsorption by activated carbon, and absorption into a liquid are the most effective odor control methods. Future efforts will be directed toward more efficient oxygenation of liquid wastes by smaller volumes of air. Municipal incinerators will be installed at plants.

**64-0309**
Leone, D. E., and R. J. Benoit. Biological treatment of concentrated human waste. Journal of the Water Pollution Control Federation, 36(12):1512-1523, Dec. 1964.

A study is reported on the biological treatment of human wastes. The experimental waste contained 20 percent urine, 20 percent feces, and 60 percent water. The concentrated waste was inoculated with activated sludge, and the results were based on the chemical oxygen demand, total solids, and chemical analyses made before and after digestion of the waste with controlled pH and temperature. Highly concentrated human waste can be stabilized by activated sludge into rapidly settling solids and a clear odorless liquid in only a few hours. A 10-1 volume of activated sludge will easily stabilize human urine and feces with 15 percent of the raw waste solids transformed into gases and water. An additional 15 percent reduction can be obtained in the raw waste solids by a prohibitively prolonged anaerobic digestion.

**64-0310**

Ludwig, H. F., E. Kazmierczak, and R. C. Carter. Waste disposal and the future at Lake Tahoe. Journal of the Sanitary Engineering Division, American Society of Civil Engineers, 90(SA3):27-51, June 1964.

To protect the beauty of Lake Tahoe, the buildup of nitrogen and other nutrient substances in the lake from community wastes produced in the Tahoe Basin will have to be reduced. A study was initiated which provided for: collection and evaluation of background information on geography, climatology, hydrology, geology, land use patterns, water supply, and sewerage facilities; sampling and analysis both of the lake waters and of representative streams in the basin; tests for evaluating ground capacities for receiving effluents by infiltration; and several special studies including evaluation of the biological productivity of the lake waters based both on laboratory and in situ testing. Three alternative feasible methods of disposal, for which costs are competitive, were recommended: (1) export from the basin to Nevada, other than via the Truckee River, where the waste effluent would be valuable for irrigation purposes; this plan would include sufficient treatment to meet regulatory standards, including protection of public health; (2) discharge to the Truckee River, following a similar high degree of treatment; (3) discharge of treated effluents to the lake water, through outfalls reaching adequate depths, following special tertiary treatment for removal of both nitrogen and phosphorus. However, this method requires pilot scale in situ demonstration before its effectiveness can be known. The cost of all alternatives is in the range of $400 per 1,000,000 gal.

**64-0311**

McCarty, P. L., I. J. Kugelman, and A. W. Lawrence. Ion effects in an aerobic digestion. Stanford, Department of Civil Engineering, Stanford University, Mar. 1964. 152 p.

Effects of inorganic and organic ions on anaerobic waste treatment process were investigated. Anaerobic treatment is an efficient method for treating many organic wastes. It is used to treat concentrated sludges from municipal waste treatment and concentrated and dilute waste from industry. Because waste is converted to methane gas, a useful product, anaerobic treatment is more advantageous than aerobic. It also produces more complete degradation and less biological cells. Anaerobic treatment still is not widely employed, due to the lack of understanding of the complex effects of high concentrations of inorganic materials normally present in industrial and municipal wastes. Sodium, potassium, calcium, magnesium, and ammonium cations were first studied. These ions, commonly found in sewage sludge and industrial wastes, are relatively soluble under anaerobic conditions. Each ion had an optimum condition, at which treatment efficiency was best. Antagonism occurred when at least one ion's optimum concentration counteracted another's inhibitory concentration. Heavy metals--copper, zinc, nickel, and iron were studied next. Only iron was not toxic to the process. Precipitating the heavy metals with sulfides relieved their toxicity. Sulfides are often produced in treatment from degradation of sulfates and protein reduction. Sulfide addition must be done with care, for they are corrosive and toxic at low or high concentrations, unless present as insoluble metal precipitates. Volatile acids were found to result from, not cause failure of the anaerobic progress. More than one digestion parameter must be considered to control anaerobic treatment.

**64-0312**

Michaels, A. Treatment and disposal of solid wastes. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.99-107.

There are three major reasons for considerable immediate concern about the refuse disposal problem: overall population growth; growth of urban areas; and increased per capita production of refuse. If such trends continue, it is reasonable to conclude that the acuteness of the refuse disposal problem can be defined as a geometric progression when related to time. In addition to incineration, the other methods of disposal are sanitary landfilling and open dumping, composting, hog feeding, garbage grinding, salvage and reclamation, and dumping at sea. The methods are briefly described. In order to determine the areas of greatest need from a research standpoint, it is advisable to first note the current status of the science and art of refuse disposal, and then point out the problem areas. The problem areas are discussed in length. At the present time, the problem of sludge disposal is in some respects comparable to the problem of refuse disposal and the use of garbage grinders would aggravate this problem. Therefore it is suggested that there is a need to research such processes as: incinerating sludge in combination with refuse; disposing of sludge with refuse in sanitary landfills; and disposing of sludge and refuse combining by composting. Under certain particular conditions, some salvaging and reclamation has proven economical. Another major problem which is rapidly becoming most acute is that of the disposal of abandoned automobiles, which is primarily a problem in economics.

**64-0313**
Morgan, P. E., and E. F. Clarke. Preserving domestic waste samples by freezing. Public Works, 95(11):73-75, Nov. 1964.

Freezing was investigated as a means of obtaining both chemical and biological stability of waste samples for an extended period of time. The main chemical analyses performed on sewage from the City of Ames, Iowa, were the biochemical oxygen demand test (BOD), the chemical oxygen demand test (COD), solids and nitrogens. Comparisons were made between fresh samples and ones that had been frozen for 2,3, and 6 days. The collection of the samples is described; the time elapsed from collection to depositing in the deep freeze did not exceed 30 minutes. The results of three complete series of tests, presented in a table and series of graphs, showed that: (1) the COD shows no significant change between the fresh and frozen samples; (2) the solids content of the samples remained essentially unchanged after freezing; (3) the various forms of nitrogen present remained the same on both the fresh and frozen samples; (4) no conclusions could be presented in regard to the BOD determination, since the presence of toxic material in the samples caused unpredictable behavior. Conclusions are that there is no significant change due to freezing in the composition of domestic waste.

**64-0314**
Morris, J. C., and W. J. Weber. Adsorption of biochemically resistant materials from solution. 1. U.S. Public Health Service, May 1964. 74 p.

Studies on the kinetics of adsorption on granular carbon showed that: (1) Uptake from dilute solution proceeds slowly for compounds of high molecular weight such as tetradecylbenzenesulfonate and dodecylbenzenesulfonate; equilibrium obtains only after several weeks; (2) The rate of adsorption is a linear function of the square root of concentration, that is, a greater fraction of solute is adsorbed per unit time the more dilute the solution, which implies that the process favors removal of trace quantities; (3) Rates of adsorption decrease considerably with increasing size of adsorbate when the amount adsorbed per unit time is expressed in molar units, when expressed in weight units the effect is much less pronounced; (4) The configuration of the adsorbate molecule affects rate of uptake: molecules with highly branched structures are removed much more slowly than those of identical molecular weight but with a configuration that permits coiling or attainment of compactness; (5) Rates of adsorption per unit weight of carbon vary reciprocally as the square of the diameter of individual carbon particles; and (6) The rate of adsorption of alkylbenzenesulfonates increases with decreasing pH of the solution. The findings correlate with equations derived for infraparticle diffusion, which indicates that the rate of adsorption is controlled by rate of diffusion of solute within the micropores of the carbon. The report includes explanatory tables and figures.

**64-0315**
Municipal waste treatment progress. Public Health Reports, 79(7):612, July 1964.

The year 1963 surpassed all previous levels for construction of municipal waste facilities, with contract awards of $679 million.

Municipal construction was 25 percent over 1962 and 50 percent higher than 1961. Including other construction costs, this represents an expenditure of $820 million in 1963. Associated with it was federal aid under the Water Pollution Control and Public Works Acceleration Program totaling $160 million and $660 million in state and local funds. A steady improvement in pollution control from municipal wastes occurred from 1960 through 1963. Because of new needs, however, all available federal, state and local resources will be required to maintain current progress in water pollution abatement. The survey found 2,677 communities lacking sewers, with 1,462 communities possessing obsolete or deficient treatment plants. The estimated cost to rectify these two situations is $1.9 billion.

**64-0316**
New York apartment building installing trash destructor. Refuse Removal Journal, 7(3):22, Mar. 1964.

An automatic refuse disposal method is being built in the new Pavilion, a 35-story luxury apartment house on New York's east side. The new technique eliminates unsightly ash cans because it employs a burning and conveyor system that passes the ashes directly from the building to the collection truck.

**64-0317**
Okey, R. W., R. L. Cohen, and D. D. Chapman. The effects of miscellaneous wastes on mesophilic activated sludge: cellulose. Brooks Air Force Base, U.S. Air Force School of Aerospace Medicine, 1962. 8 p.

A broad spectrum microbial culture similar to activated sludge in utilizing cellulose has been evaluated for its ability to utilize wastes. The metabolism of cellulose was followed in Warburg and substrate depletion studies by utilizing measurements of chemical oxygen demand. Activated sludges were developed on cellulose as a sole carbon source and on human waste with added cellulose designed to simulate the waste which would be received in a remote environment. From the Warburg and substrate depletion studies, constants of first-order oxidation rate were obtained. The first-order oxidation constants were found to vary between 0.0133 and 0.0146 reciprocal hrs. It was observed that a lag period varying from 400 to 1,500 minutes precedes the utilization of cellulose by the microbial system.

**64-0318**
Okey, R. W., R. L. Cohen, and D. D. Chapman. Effects of miscellaneous wastes mesophilic activated sludge: soaps, detergents, and vomitus. Brooks Air Force Base, U.S. Air Force School of Aerospace Medicine, May 1963. 9 p.

Effects of soap, synthetic detergents, and vomitus on the performance of high solids mesophilic activated sludge biologic-type waste reactors designed for extended manned space flight are reported. System performance was determined by oxygen uptake measured by microrespirometer and degree of side effects. Castile soap and the detergent sodium dodecyl sulfate were metabolized rapidly, and no deleterious side effects were exhibited. Eight other cleansing agents had serious disadvantages due to slow biodegradabilty or extreme foaming or both. The relationship between biodegradibility and chemical structure of the nonionic and anionic synthetic detergents is discussed. Human stomach content of nonpathologic origin was found to be rapdily metabolized, and pH depression as would result from the discharge of vomitus through a waste treatment system had only slight observable metabolic effect though pH 4. The disposal of selected cleansing agents, vomitus, and pH depressant substances posed no apparent problems.

**64-0319**
Poepel, F. and K. Hunken. The waste problem in large cities. Wasser und Abwasser, 105(18):481-485, May 1964.

A survey of methods for cleaning waste water, of various types of purification plants, and of the various ways of eliminating household and industrial wastes as well as sludges is given. The most common method of waste removal is deposition. In the area Mannheim-Ludwigshafen-Frankenthal, West Germany, about ten large disposal sites are presently in use. The dumping of waste is the simplest and least expensive method. Incineration and composting are two rival methods. The composition of the waste (i.e. the ratio between the easily combustible substances and the substances decomposable by bacteria) determines which method to choose. Investigations showed that combustible substances are preponderantly contained in industrial wastes, while domestic waste is composed of a greater part of putrescible substances so that incinerator plants are commonly located in industrial centers. As far as household wastes are concerned, the question of whether to incinerate or compost is far more difficult to decide. The mere fact such wastes are suited for composting is not enough. A comparison of the costs involved in both methods will decide the question. (Text-German)

**64-0320**

Portable stations for refuse analysis.
Wasser, Luft and Betrieb, 8(5):277, May 1964.

The Research and Development Institute in Stuttgart, in cooperation with the Engineer Bureau for Health Technique, has developed a portable refuse analyzer, which was designed and built by the firm of Hazemag, Muenster. This device has been used in Schleswig-Holstein since 1963. The maching is mounted on a trailer and its portable aspect allows it to service four different places within one week. The analyzer determines the moisture content of the refuse on the spot. The other samples are air-dried and sent to the laboratory at Stuttgart, where the total organic content, the ash, the amount of active organic carbon, the available organic nitrogen, the cellulose and salt content, as well as the amount of active toxic materials, are determined. The pH, the calorific, and self-heating value are determined as a control test for its fitness for composting. (Text-German)

**64-0321**

Quon, J. E., W. O. Pipes, and J. A. Logan.
Combustion of human waste and product recovery. Technical Note TN 62-16. Fort Wainwright, Arctic Aeromedical Laboratory, Oct. 1963. 8 p.

Study on the kinetics of combustion of volatilized wastes was continued. A new method of carbon dioxide analysis was tried and proved more satisfactory than the Orsat Apparatus. Algal growth studies (Chlorella) with the ash from the volatilization chamber were continued. Additional information on the relationship between residual weight and oxygen supply, and between residual carbon and oxygen supply was obtained with the volatilization chamber operated at 200 C. Results showed the characteristics of the raw urine and feces mixture were very similar to those reported previously. The carbon content with respect to time indicated that a relatively short period of high temperature is sufficient to volatilize the waste, provided the waste is in a predried state. From the standpoint of waste disposal, it may suffice to reduce the carbon content of the waste to less than 40 percent. The solubility of the residue varies for different raw samples. A comparison of the solubility data at 300 C and 400 C shows that the weight of soluble material increases with the degree of oxidation of the organic matter in the waste. Algal growth was not supported by a carbon and nitrogen source alone.

**64-0322**

Quon, J. E., W. O. Pipes, and J. A. Logan.
Gross chemical changes of human waste undergoing thermal decomposition. Technical Note 63-13. Fort Wainwright, Artic Aeromedical Laboratory, Oct. 1963. 9 p.

Detailed characterization of the volatilization of human wastes is studied. Gas analyses on the volatilization chamber effluent were made, using an Orsat Apparatus. Solubility and carbon content of the residue after ignition at 400 C were determined for different rates of air supply to the volatilization chamber. A series of experiments to determine if the solids residue remaining after the volatilization of human wastes contained nutrients adequate for algal growth was also undertaken. Tables were compiled showing the characteristics of the raw urine and feces mixture, solubility of residue, the residual weight and carbon content of the ash with respect to time for different operating conditions of the volatilization chamber, distribution of carbon in the various forms, and the qualitative growth characteristics of Chlorella.

**64-0323**

Refuse disposal by contract extraordinary.
American City, 79(2):38, Feb. 1964.

Bidding opened by St. Petersburg, Florida, for a 300 ton per day refuse disposal facility under a 20-year contract is described. The specifications and requirements for the project are briefly outlined.

**64-0324**

Refuse disposal plan for the Detroit region.
Detroit Metropolitan Area Regional Planning Commission, 1964. 189 p.

The scale of the disposal problem of garbage and rubbish was examined and projected to

1980. Existing and proposed methods of disposal were evaluated as to their adequacy, feasibility and costs. Two alternate plans were formulated, with engineering costs computed and organizational methods suggested. Plans for the re-use of sanitary landfill areas were developed in relation to the Commission's recreation and land use plants. The results of these steps are presented in this report. The report is divided into six parts, each of which is further divided into chapters. Subject headings for the parts are: Introduction, Refuse Collection, Disposal of Refuse, Land Use and Refuse Disposal, Regional Plan for Disposal of Refuse, and Future Land Use for Refuse Disposal Areas. Appendix A is concerned with garbage and rubbish collection and disposal in the Detroit metropolitan region and Appendix B deals with suggested minimum standards. An organizational chart of the planning commission executive committee and staff is also given.

**64-0325**
Refuse Removal. Technische Ueberwachung, 5(1):34, Jan. 1964.

In this summary of an article on refuse removal by W. Spichal in Gesundheits-Ing. (84(4):97-102, 1963), controlled storage, composting, and incineration are discussed. The amount composition, heating value, and source of refuse in two large cities are tabulated in the original article. In choosing a removal method, knowledge of the composition and heating value is particularly important. At the present time, most of the refuse is stored. Control methods for storage include protection of the drinking water and avoidance of bad odors and vermin. Physical and biological measures yield a better end product during composting. Three different methods of refuse removal are cited and illustrated. Incineration is considered the most hygienic method. The composition of the refuse and the proper design of the incinerator to prevent dust discharge are important considerations in this method. (Text-German)

**64-0326**
Research on refuse disposal. Surveyor and Municipal Engineer, 123(3753):32-33, May 9, 1964.

Subjects presented in a paper delivered by the International Research Group on Refuse Disposal were an analysis and evaluation of refuse for incineration and composting, and an analysis and evaluation of the products of these disposal methods. Tedious, expensive systems for examination of individual incinerator constituents were discussed and the idea of collective analysis suggested. Also, international standardization of the method of analysis was advised. Biological processes during composting were mentioned. The effect of compost on plants and soil was compared with that of stable manure.

**64-0327**
Research work on refuse disposal. Public Cleansing, 54(6):936, June 1964.

A report on the work to date of the International Research Group on Refuse Disposal (IRGRD) is summarized. The paper provided analysis and evaluation of refuse for disposal by incineration and composting and of the final products of these methods. Composting was approached in two ways--as producing a harmless material for dumping and as producing a saleable product. The effect of dumped incinerated refuse on ground water was also considered.

**64-0328**
Rogus, C. A. Refuse quantities and characteristics. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.17-27.

The lack of essential information on the quantity and characteristics of refuse can be attributed to the following: complexity of measurement; difficulty in standardizing sampling and laboratory techniques; general failure to recognize the need for this information; and geographical distribution. Only a nation-wide, centrally directed effort will provide the required answers. The various solid wastes now extant in this country are defined and described; the several criteria that affect the quantities and character of refuse produced are discussed; existing knowledge of quantities and characteristics is reviewed; and the types of information required are suggested, including reasons therefor. Although in the past and to a substantial degree even today quantities are reported by volume, usually cu yds, it is almost self evident that reporting by weight, in lbs or tons, is the more accurate method. The factors which affect refuse characteristics and the total output for municipal handling are enumerated. It is concluded that there now exists a lack of consistently dependable knowledge of refuse quantities and their seasonal and yearly variations and changes. There is a similar lack of information as to refuse characteristics, and physical and chemical properties. The absence of this essential information largely exists because the required overall nation-wide development of uniform standards of measurements and of analysis has not been made to date.

**64-0329**
Rolle, G. Problems in analysis of refuse, compost, and sewage sludge. In International Research Group on Refuse Disposal (IRGRD). Information Bulletin No. 20. Washington, U.S. Department of Health, Education, and Welfare, May 1964. p.51-55.

A simple orientation for a practitioner is to know the moisture content, total and usable organic matter, and the calorific value. These data are of interest in all disposal methods. Additional data must be known when dealing with industrial wastes. When examining compost, it is desirable to know such things as elemental composition, pH, and organic content. Because of the heterogeneous nature of composts and refuse, problems exist in sampling, drying, grinding and homogenizing. The problem is to get results which are representative of the material. The accuracy of analysis plays an important role in the choice of methods, as does the element of time. The goal is to obtain comparable results from all participating laboratories through unified and standardized methods of analysis. This is only possible if the laboratory equipment is very similar.

**64-0330**
Sanitary facilities on country main roads. Surveyor and Municipal Engineer, 124(3782):30, Nov. 28, 1964.

Reports and talks given since 1960 on providing sanitary facilities and litter bins for through traffic on country main roads are reviewed. It is recommended that washing facilities be included in the project, and that the resulting sewage should be dealt with by small domestic-type automatic disposal works. The main concern in the article is financing the construction and maintenance of these facilities. The idea is presented that the Ministry of Housing and Local Government--not the Ministry of Transport--should pay these costs.

**64-0331**
Scott, M. The future of San Francisco Bay. Berkeley, University of California, Sept. 1963. 125 p.

The Institute of Governmental Studies provides a comprehensive overview of the entire bay dealing with: an account of the history of the division of the bay among many private owners and units of government; the physical, economic, and political pressures affecting use of the bay and tending to reduce its size; the economic resources that may be jeopardized by further unplanned and uncontrolled filling; the increasing need to use the bay for the disposal of wastes and flood waters, and the potential conflict between these requirements and demands for various filling projects; the great potential of the bay for meeting regional recreational needs; and the political choices and decisions facing the people of the Bay Area as they seek to safeguard the bay for present and future generations. The preparation of a plan as a first step is ending the present costly and potentially ruinous piecemeal planning and development of the bay and shore areas is proposed. Areas discussed are: the divided bay; the shrinking bay; the productive bay; the polluted bay; the neglected bay; and the future bay maps, bibliography, and appendices are furnished. As the population steadily increases to the 14 million mark for the area, the daily accumulation of solid wastes will rise to 28,000 tons, and if sanitary landfill method of disposal should continue to be used, a great many square miles of San Francisco and its marshlands may disappear.

**64-0332**
Shaeffer, J. R., B. von Boehm, and J. E. Hackett. Refuse disposal needs and practices in northeastern Illinois with refuse disposal policies for northeastern Illinois. Technical Report No. 3. Chicago, Northeastern Illinois Metropolitan Area Planning Commission, June 1963. 72 p.

A technical report on present refuse disposal practices and facilities and future refuse disposal needs in northeastern Illinois, preceded by an official statement of policy on refuse disposal planning which was adopted by the Northeastern Illinois Planning Commission on April 18, 1963, are presented. Chapters cover: refuse disposal--a metropolitan problem; status of refuse disposal, 1960; methods of refuse disposal; multipurpose concepts in refuse disposal; refuse disposal and ground-water pollution; the relation of refuse disposal to urban society; space needs for refuse disposal; and a metropolitan approach to refuse disposal. All of these topics are discussed in relation to the northeastern Illinois refuse situation. Appendices give present disposal space requirements; life of existing sites; other statistics on refuse disposal sites and incinerators; and ownership and remaining capacity of refuse disposal sites by counties in northeastern Illinois. .

**64-0333**

Skitt, J. Disposal works: plant and maintenance. London, Temple Press Books Ltd., 1964. 74 p.

Each of the successive operations which take place in a normal disposal works is examined in detail including: the reception hopper, screening, magnetic separators, belt conveyors, dust control, the furnace, power production, trade refuse incinerators, general considerations, and maintenance.

**64-0334**

Smoke control problems. Public Cleansing, 54(2):752, Feb. 1964.

The meeting of England's North-Western Centre is reviewed. The Cleansing and Transport Superintendent of Burnley spoke on the problems affecting his department since the institution of smoke control, such as inadequate bin size, excess refuse created by public holidays, removal of refuse from multi-story flats, and inadequate incinerators. Possible solutions are offered in the discussion afterwards.

**64-0335**

Solid Research needs for solid wastes. Public Health Reports, 79(2):97-100, Feb. 1964.

Trends in the nature and amount of solid wastes and the means of disposal were reviewed at a conference on research on solid wastes sponsored by the Public Health Service and the American Public Works Association on Dec. 2, to 4, 1963. The volume of solid waste has grown more rapidly than the population at the same time that the available economic space for waste disposal has declined. A graph is given showing the growth of refuse and population coincident with the decline in the available land. The ideal method of disposal would be to convert the wastes into useful marketable forms by swift, inoffensive, silent, economical, and invisible processes. In the meantime, the engineers will settle for compaction into bales for burial, controlled combustion without flyash or noxious fumes that will reduce the weight load by 90 percent, and better means of disposing of residue, junk, and organic wastes. Since collection and transportation amounts to 85 percent of the waste disposal budget, the hope is for effective methods of disposal within the home, but garbage disposals transfer the load to the sewers and incinerators produce air pollution. Machines costing up to a million dollars are available for shredding old automobiles after removing the battery, radiator and tires and burning the upholstery. Vegetable wastes, formerly discarded by the housewife, are now stacked near the packing plant. It was agreed that the research budget of $200,000 for the Public Health Service for the management of the $3 billion expenditure in solid waste disposal was inadequate.

**64-0336**

Taking a well-planned approach to waste disposal. Chemical Engineering, 71(5):48-50, Mar. 2, 1964.

The disposal of liquid wastes by pumping into deep wells is discussed. Oil and gas companies have used deep wells for over 60 years to dispose of brines. NASA plans to use a deep well to dispose of spent acid used to clean out lines in a rocket plant near New Orleans. A paper plant in Pennsylvania has plans for underground disposal of spent liquor. In some cases, chemical pretreatment provides for flocculation, neutralization or sterilization before pumping underground. It is important before initiating such a program to review the state laws, subsurface geological conditions, and chemical or physical problems which might result. Sandstone strata are suitable if they are permeable and porous enough. Limestones are highly suitable and their permeability can be increased by hydrochloric acid. The volume of waste should be reduced by concentration or by removal of relatively harmless constituents. Liquid wastes can be advantageously disposed of in many cases by pumping into deep walls.

**64-0337**
Teletzke, G. H. Wet air oxidation. Chemical Engineering Progress, 60(1):33-38, Jan. 1964.

Wet air oxidation is the process of oxidizing organic matter in the presence of liquid water. In treatment of concentrated industrial waste streams, the objective is to reduce the oxygen demand of the waste stream before discharging to a receiving body of water. The objectives in treating sewage sludge are to eliminate any potential health hazards and to economically reduce the volume of solids remaining for disposal. The waste or sludge, ground to ¼-in. size, is delivered to the storage tank to be preheated to 60 to 80 C. The material to be oxidized has a high water content and low fuel value. It is brought into the system by a positive displacement high pressure pump where it joins a metered amount of air. The mixture passes through a series of heat exchangers and is brought up to 200 C at which oxidation proceeds spontaneously. The oxidation products leave the reactor at temperatures of 220 to 320 C. Gases are separated from the liquid stream. A major part of power requirements may be recovered. Insoluble organic removal is accomplished both by solubilization and oxidation. Sludge volume reductions of 50 to 90 percent are expected with a short settling period after oxidation. Both raw and digested sludge have been handled. Organic nitrogen in sludge is converted to ammonia which can nearly quantitatively be returned to the biological treatment step and reutilized for treating industrial wastes deficient in nitrogen. Data, flow diagrams and graphs are included. Table one lists typical operating conditions for several sludge oxidation plants.

**64-0338**
University of West Virginia sets up first solid wastes course. Refuse Removal Journal, 7(11):31, Nov. 1964.

The West Virginia University Department of Civil Engineering will offer a three-credit-hour graduate course in Solid Waste Disposal. The course will be a part of an air pollution control graduate training program.

**64-0339**
Waste analysis with a mobile station. Wasser und Abwasser, 105(38):1062-1063, Sept. 1964.

To decide in each case which is the most expedient and most economical method of waste disposal, prior investigations as to the amount and the composition of waste are necessary. For an efficient analysis, the Institute for Research and Development in the Field of Industrial and Residential Water Economy as well as Waste Problems, in cooperation with the Bureau for Health Technology, developed a mobile station for waste analysis which has been in operation since August 1963. The station, erected on a movable trailer, comprises a sifting machine, a hammermill, and the necessary accessories like conveyor belt and scales. Approximately 3 cu m of waste are taken, crushed and thoroughly mixed. The water contents of the waste must be determined immediately. Then 21 samples are taken, dried and sent to the laboratory in Stuttgart, West Germany, where the organic and toxic substances, the ash cellulosis, salt, nitrate, carbon contents, the pH value, heating value and the self-heating ability (required for composting) are determined. This sample analysis of waste must go on throughout the year to get an idea of how the seasons affect the waste composition. The costs for this analysis are composed of the rent of the station (annual operating costs per station--14,000 DM), of the salaries for the personnel in the laboratory (usually one engineer and one technician), of the travelling expenses for the personnel, and of the money for transportation of the station, the laboratory tests (1,000 DM per week), and the evaluation of the analysis.

**64-0340**
Waste treatment digest. Water and Waste Treatment, 9(12):608-610, Mar.-Apr. 1964.

Five papers on waste treatment are reviewed: (1) In a study of the settling properties of humus in settling tanks, it was found that the degree of purification in the filter has a major effect on the settling: the average concentration of suspended matter discharged increases linearly with decreasing specific surface of the filter. (2) In an investigation of the treatment of gas-liquor, it was shown that the biological treatment of conventional gas-liquor can be carried out to a high degree of efficiency at loadings of the order of 60 lb PV per 1,000 cu ft per day are possible. (3) An investigation is reported on the amount of additional percolating filter capacity required when spent liquors from carbonizing plants are discharged to sewers; assuming an effluent BOD of 8 ppm, the additional filter capacity required when continuous vertical retort liquor was added to Knostrop sewage was from 0.65 to 1.14 cu yd. (4) The new sewage works at Dunstable which features 14 acres of oxidation lagoons and serves 36,000 persons has a dry weather flow of 2.2 million gal per day, of which 300,000 gal are trade waste. Because of the low dilution, the effluent standard is 15 ppm BOD and 15 ppm suspended solids. (5) In a program of field testing for flotation thickening of waste activated sludges, the Koline-Sanderson Corporation found that flotation aids such as polyelectrolytes were necessary in order to provide loadings of 3 lb per sq ft per hr with a 4 to 6 percent solid sludge.

**64-0341**
Winton, J. The detergent revolution. Chemical Week, 94(22):111-126, May 30, 1964.

'Hard' detergents are only partly destroyed in sewage treatment plants and eventually foam up in surface and tap water. Foam reduces sewage plant efficiency and necessitates costly chemical or mechanical control means. Only 40 to 60 percent of alkylbenzene sulfonate (ABS) which results is degraded under secondary sewage plant treatment. The maximum permissible level of ABS in drinking water is 0.5 ppm. Variations in operating conditions of secondary sewage plants can reduce the 95 to 98 percent biodegradability theoretically attainable with linear alkylate sulfonate (LAS). The most popular test for biodegradability is dosing river water with surfactant and the process of aerobic biodegradation is followed analytically until the residual surfactant concentration levels off. Most industry centers on two tests: activated sludge revealing variations in surfactant molecular structure, and fill and draw. Demand for heavy-duty, high-foaming solid formulations has reached its peak. Normal paraffins are being used as starting materials for linear alkylate and secondary alcohols. Alcohols will enter detergent markets mainly as ethoyether sulfate anionics and ether alcohol nonionics. LAS does not degrade significantly under aerobic conditions at temperatures between 10 and 35 C. Clay minerals do not appreciably absorb ABS from waste water. ABS is adsorbed under conditions of saturated flow through soils. Coliform bacterial populations were discovered in household disposal and in downstream well systems resulting from switching from detergent to soap.

**64-0342**
Wuhrmann, K. An investigation on the significance of plant size for refuse disposal by incineration or composting in rural areas. In International Research Group on Refuse Disposal (IRGRD). Information Bulletin No. 20. Washington, U.S. Department of Health, Education, and Welfare, May 1964. p.41-51.

In refuse disposal plants, plant size is an important fact in specific operating costs. This is because only low value products are treated. The smaller the community, the higher per capita construction costs are. In rural areas, complete disposal facilities are not needed because some dumping can be done. With a greater density of population or higher per capita yield, the characteristics will change so that appropriate treatment costs must be added to the smaller hauling costs.

**64-0343**
The year in Manchester. Public Cleansing, 54(2):735, Feb. 1964.

Some notable items of the annual report of the Cleansing Department of Manchester, England. are: percentages of solid wastes disposed of at different sites; the effects of the paper bag system; the effects of reorganization which has increased personnel productivity 50 to 80 percent; the fostering of morale by bonus payments; and a discussion of the problem of illegal dumping.

## AGRICULTURAL WASTES

**64-0344**
Adams, J. L. Hydraulic manure systems. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.149-159

Since fresh hen manure consists chiefly of bacteria, it should be theoretically possible to provide an environment which would allow these microorganisms to convert the organic solids of the manure to gases, which could then be removed by forced ventilation. Unfortunately, efficient reduction of the solids by bacteria without odor requires: aerobic bacteria; temperatures above 50 F; sunlight and/or aeration; and extreme dilution. Fresh hen manure is about 80 percent water. The addition of water while pumping greatly facilitates the flow of the material, and the equipment and power needed to move large quantities of liquid is very small in comparison with that needed to move semi-solid manure. Agitation is necessary either immediately before or during pumping to move the sludge. The difficulties encountered in handling manure hydraulically are reported. Disagreeable odors are encountered particularly in situations where ventilation is poor. A outboard motor was modified to provide the necessary agitation. Special equipment may be needed where gravity spreading is not possible. Advantages of the hydraulic systems currently in use are: flexibility of time of cleaning; ease of handling; the fact that the gases released may be less objectionable than high concentrations of ammonia characteristic of decomposing poultry manure; the control of flies; less expensive equipment required; and the fact that temperatures in houses over large liquid filled pits are more constant. The space in pits required to provide storage for manure at 80 percent moisture was calculated to be 1.45 cu ft for 90 lb of manure. A pit is diagrammed and the features of its design discussed.

**64-0345**
Aust, A. Social, legal and economic considerations of animal production in urbanization. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.225-240

The growth of urbanization and the social developments which have been affected by it are discussed. Those social developments that restrict the location of new industrial animal processing plants and impede the operation of existing plants are: the growth of large concentrations of people in close proximity; the technological advances achieved in the last 25 years; and the growing affluence, education, and cultural sophistication of our society. People are becoming more critical of obnoxious industrial practices, and are more insistent that corrective measures be taken. The legal developments which have been accentuated by urbanization are discussed. These legal developments are a direct result of the social developments and may be categorized into: (1) planning controls; (2) public health controls; (3) public safety codes; and (4) aesthetic controls. Planning controls include zoning and land use control and such techniques as the Master Plan and the Capital Improvements Program are used. The public health controls include waste and sewerage disposal, and air pollution control. Public safety controls include building codes, fire prevention codes, and safety or accident prevention codes. Aesthetics of urban life is documented by a Supreme Court decision. The three courses of action open to the poultry processing industrialist are: the laissez-faire approach; the self-sufficient or self-contained approach; and the cooperative or good citizen approach. The cooperative good citizen approach in conjunction with the local city planning department is suggested.

**64-0346**
Barnebey, O. L. Odors and their control. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.57-65.

Five problems relating to odors and air pollution are: (1) general housekeeping; (2) the feather problem, which would not exist if there was prompt removal of the feathers; (3) odorous and dryer gases produced by cooking feathers which can be removed or diminished by piping into scrubbing towers; (4) feather meal dust from grinding and drying which can similarly be removed through ducts to scrubbing towers; and (5) 'holding ponds' for organic waste which are open-topped anaerobic reactors with no means of destroying the gases produced and hence are to be condemned. A collecting duct system operating under suction will bring all the gases to a central location for deodorizing treatment. The gases are first cooled and treated by washing with water sprays, wet plates, etc. After a thorough scrubbing with water the gases should be contacted with 'knockout plates' or their equivalent to provide surface for removing the entrained water. The addition of an alkali to remove hydrogen sulfide along with other organic compounds may be desirable together with further purification by passing the gas through activated carbon. The activated carbon will absorb odors and other organic compounds to a high percentage by weight of carbon but will eventually become saturated and require distilling by steam to remove the gases. The equipment needed is described.

**64-0347**

Bell, D., J. Mamer, R. Peters, and O. D. Forker. Urbanization's impact on California's poultry industry. Pacific Poultryman, 68(2):12-14, 62, 65, Feb. 1964.

The shifts in California's egg industry, aspects of zoning as they affect poultrymen, the fly problems and factors affecting relocation of poultry farms as a result of urbanization were discussed at the Western Poultry Congress in San Jose, California, November 1963. The poultry population in California is estimated at 32 million layers in 1964. About 25 counties in California have been or are in the process of establishing exclusive agricultural zones. The fly problem is a very extensive one throughout California and is growing in size and intensity. Present studies being made in aerobic composting, suggest this method could be an answer to the problem of manure and other organic wastes. It is suggested that the poultry industry develop a program to bring about systematic storage, collection and management of all wastes capable of producing domestic flies.

**64-0348**

Black, R. J. Public Health aspects of poultry waste management. Presented at the National Symposium on Poultry Industry Waste Management, Lincoln, May 13-15, 1963. University of Nebraska. 3 p.

In the poultry industry, optimum utilization and reduction of both liquid and solid wastes are essential for economic production in small as well as large operations. Wastes which cannot be utilized must be disposed of in a suitable manner. Practices are changing so rapdily in the poultry industry that there is insufficient technical information available to deal effectively with many of the problems. Some poultrymen have already constructed facilities for the lagooning of poultry manure even though the basic research work necessary to establish design parameters and to determine the limitations of this method is still underway. Another problem that has concerned the poultry industry and public health workers is salmonellosis. Since offal generally is sold as raw material for rendering or processing into animal and poultry feed, care must be taken to handle these by-products to prevent their innoculation after heat treatment. If not, new birds are soon infected by the feed. Poultry solid waste problems have been largely ignored. This is serious on light of the fact that, today, individual poultry ranches commonly have flocks of 40,000 to 50,000 birds, and continued urbanization has steadily gobbled up nearby undeveloped property.

**64-0349**

Black, R. J. Sanitary landfilling of poultry wastes. Presented at the National Symposium on Poultry Industry Waste Management, Lincoln, May 13-15, 1963. University of Nebraska. 5 p.

There are two types of sanitary landfill operations of interest to the poultry industry in disposing of poultry wastes, which include manure, feathers, litter, carcasses, and offal. They are the public sanitary landfills that are operated for the disposal of refuse and other solid wastes, and the sanitary landfills that are operated for only the disposal of poultry wastes. Costs of operation, types of wastes accepted, methods of financing, and user charges vary widely, so that local conditions and hauling distances must be investigated to determine the feasibility of utilizing sanitary landfill facilities for the disposal of poultry wastes. When poultry wastes are disposed of by themselves, trenching is the method of choice, because poultry wastes ordinarily can be expected to have a high water content during at least part of the year. If the poultry wastes are so liquid that the earth cover sinks, the only recourse is to use a 2 to 3 in. layer of straw of other dry waste material for cover to prevent fly oviposition. While the average poultryman may not have suitable land of equipment to operate a sanitary landfill for his own use, it may be feasible for several poultrymen to jointly finance such operations. Two phases of fly control work that are important in the operation of sanitary landfills are preventing further oviposition and preventing fly emergence. Further oviposition can be prevented by covering all exposed wastes. Field tests have shown that under usual conditions, a 6-in. layer of compacted cover prevented fly emergence. (Separate Paper)

**64-0350**

Bloodgood, D. E. Waste disposal concepts. In Proceedings; Second National Symposium on

Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.11-22

The decomposition process and the mechanisms of manure disposal are discussed. Septic tanks have been used for controlled decomposition for many years. More recently, the solids in sewage and industrial wastes have been removed in settling tanks and then transferred to heated digestion tanks where decomposition takes place. The seemingly omnipresent organisms that carry on the decomposition require hydrogen, carbon, oxygen, nitrogen, phosphate, and small amounts of other elements. These anaerobic organisms require oxygen derived from compounds in which oxygen is part of the molecule. The solids from sewage and garbage are readily decomposed by anaerobes. The application of the anaerobic process in a lagoon is considered for poultry waste. Laying hens produce 142 lb per yr of manure with a moisture content of 75 percent. A house with 12,000 hens will contribute solids equivalent to the suspended sewage from a city with a population of 6,000. The factors important in anaerobic digestion are: pH, alkalinity, volatile acids, nitrogen, loading rate, and temperature. Most lagoons digesting sewage sludge operate in the alkaline range, the system being dependent upon nitrogen. The first step in the decomposition of organic matter to carbon dioxide and methane is the conversion of the organic solids into volatile organic acids. The maximum loading rate has not been determined for anaerobic systems. Anaerobic decomposition in a temperature range of 90 to 100 F seems to be optimum. Lagoon construction and operation are discussed. To prevent the possibility that the high nitrogen content might result in too high a concentration of ammonium bicarbonate. a small flow through the lagoon is suggested. Sludge must be removed from the lagoons periodically

**64-0351**
Breakthrough in poultry manure. Compost Science, 5(2):30, Summer 1964.

A British firm, Hydraulics Developments Ltd., had developed a process of drying poultry manure droppings and producing a dry sterile powder for use as a natural organic fertilizer. Analyses of 10 samples have an average reading of 5.3 percent phosphate and 2.1 percent potash. The company installed a plant on 20,000-bird battery unit in Berkshire, and the product is sold to horticulturists. The plant handles from 1 to 2 tons of droppings in 1 to 2 hr. Droppings, which go into a brick-lined pit outside the battery houses, are transported by a covered auger into the gas-fired plant.

**64-0352**
Brender, M. Lagoons--sink or swim. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.183-192.

The collection and disposal of poultry feces are discussed from an historical point of view. New innovations in the egg plant are described. The layers are housed four to a cage in a 'stair-step' arrangement over manure and water storage tanks, also called 'indoor lagoons' . In the multiple deck system either hand or power scraping is required to drop the manure into the tank or indirectly into a truck. In an 'indoor lagoon' poultry manure goes into a suspension during the first and second week, but with the continuous addition of manure, sludge builds up on the bottom of the tank. The construction of an outdoor lagoon is described. Odor is the major problem encountered with lagooning, although the author's outdoor lagoon was odorless, suggesting that the gases were being carried aloft. Variations of lagoons and hydraulic engineering for disposal of poultry manure are: catch manure in waterproof tanks; keep it covered with water at all times; move it out before it settles down; haul it and spread it on fields, or stabilize it on 'outdoor lagoons' ; and operate by gravity. Future waste disposal research is discussed.

**64-0353**
Bristow, A. K. From farm wastes to fertility. Compost Journal, 22(6):13, Dec. 1963-Jan. 1964.

Organic irrigation is commented on as a possible means of using farmyard muck. Because chemical fertilizers are thought to be easier to use, farmers generally let this muck drain off their land. In England and New Zealand, milking sheds and pig pens are often located near streams causing gross water pollution. If sludge were stored in a large tank and pumped to fields, it could be profitably used as an organic fertilizer. On farms that are already equipped with organic irrigation systems the farmers have all been pleased with the results.

**64-0354**
Broiler house litter for finishing steers. Pacific Poultryman, 70(11):54, Nov. 1964.

Broiler house litter with a right hull base can be used as satisfactorily as roughage for finishing yearling steers, providing a smaller quantity of long hay is fed to prevent bloat. This observation was made at the Arkansas Agricultural Experiment Station where comparisons were made on the feeding of rice hulls without fat, chicken litter with fat added, and chicken litter without fat. The addition of fat to the litter ration seemed to depress feed intake and gains for the first month. Afterward, however, intake and gains were good.

**64-0355**
Chambers, C. W., and N. A. Clarke. Health aspects of poultry waste dfsposal. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.193-212.

The diseases that are a potential threat to man by direct or indirect exposure to poultry wastes are disucssed. These diseases are caused by microflora. The three categories of disease-producing agents discussed are bacteria, fungi, and viruses. Without microflora to decompose plant and animal wastes these materials would accumulate and would not be returned to the soil and water for reuse. In most instances transmission of the disease to man is by: direct contact with waste; ingestion of waste via contaminated food or drink; inhalation or contact with contaminated dust, or spray; and contact with vectors such as flies or other insects. Salmonellosis, an illness caused by bacteria, is the most common disease transmitted from fowl to man. Eggs are a frequent source of infection. Other bacterial diseases that affect fowl and are transmissible to man are undulant fever, tuberculosis, and tularemia. Two virus diseases that are carried by poultry and are transmissible to man are psittacosis and Newcastle disease. A fungus disease associated with poultry wastes is histoplasmosis, which cannot be transmitted directly from fowl to man. Cryptococcosis is another fungus disease. Infected or carrier fowl and health hazards in poultry wastes are inspearable. A way to terminate the transmission is by continuing and intensifying the pullorum (Salmonella pullorum) test program. Testing to eliminate psittacosis from breeding flocks is beneficial. Poultry processing affects the health of both the employee and the consumer, and sanitary measures are discussed. Improved processing techniques should be developed. Problems encountered from the disposal and the spreading of manure are mentioned. All conditions that can result in multiplication of disease-producing organisms should be controlled. Efforts should be made to block disease-producing potential at the source.

**64-0356**
Culpin, C. Equipment for disposal of agricultural effluents. Chemistry and Industry, 2(9):350-353, Feb. 19, 1964.

Only recently have farmers in Britain begun to handle manure as slurry. The average daily amount of undiluted slurry to be disposed of is about 5.1 gal per dairy cow, 1.6 gal per fattening pig, and 6.2 gal per 100 head of poultry. Other agricultrual effluents include those from silage making. Transferring manure to storage tanks can be handled by mechanical scrapers, slatted dunging passages, and tractor-mounted yard scrapers. Hosing slurry into drainage channels can be effective under proper conditions. Collection rainfall in the manure storage tank should be avoided. Type of manure utilization and frequency and method of distribution govern tank size. A large lagoon emptied by a piped distribution system is sometimes practical. With a cylindrical tank design, a mobile stirrer and submerged shaft-driven pump are effective in mixing. Distribution equipment may involve a fixed pump with buried main and rainers, a large tanker with pipe line, or a medium or small tank distributor. Detailed descriptions are given of each of these four methods. Labor requirement for distributing 1,000 gal by spreader tank is 135 man-minutes, and by pipeline distribution, 30 man-minutes. Some of the unnecessary mechanical handling problems associated with the disposal of slurries are being solved, though problems of uniform application and of odor still exist.

**64-0357**
Eby, H. J. Anaerobic lagoons--theory and practice. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.77-91.

Despite the lack of objections to aerobic farm waste disposal lagoons by state public health officials, the aerobic lagoon has the following drawbacks: relatively large land areas required; relatively large quantities of water required; and enroachment of urbanization. While the original BOD of material entering an aerobic lagoon can be reduced by up to 100 percent, algae leaving the lagoon in the effluent, if not supplied with nutrients, will die and contribute to stream pollution. Where influent continues to be added, eventually there will be a build-up of organic and mineral matter to the point where green algae can no longer live and produce and the lagoon then becomes anaerobic. Anaerobic bacteria develop which produce most disagreeable odors. In the anaerobic phases of decomposition organic waste is not broken down as well, thus causing a build-up of sludge directly proportional to the loading rate. The establishment of standards for sewage treatment is complicated by the erratic and fluctuating set of values found with the livestock enterprise. Enough water flow per animal unit must go through the lagoon to carry off the digested material so that dissolved solids do not build up to the saturation point. Design recommendations are discussed for anaerobic lagoons. Because the anaerobic lagoon does not depend upon the growth of algae, sunlight is not important and the lagoon need not be limited in depth. Depths of at least 5 to 10 ft are recommended. The allowable loading rate for human and animal wastes to assure stabilization is presented in tabular form. The detention time is discussed. The operation of the lag lagoon constructed at the Swine Research Farm of the University of Maryland is described.

**64-0358**
Eby, H. J. Disposal of poultry manure and other waste. U.S. Department of Agriculture, Agricultural Research Service, 1964. 10 p.

Spreading on fields (dry or wet), ground or pelleted home garden fertilizers, lagooning, laboratory work (BOD), composting, and disposal through municipal sewage plants are discussed. Also, several methods for disposal of dead birds are given. Advantages and disadvantages of each method of disposal are listed, so that the reader may choose which would be best for his particular needs.

**64-0359**
Englebrecht, R. S., B. B. Ewing, and R. L. Hoover. Soybean and mixed-feed plant processing wastes. Journal of the Water Pollution Control Federation, 36(4):434-442, Apr. 1964.

Soybeans have become an important crop for American agriculture and are used for many purposes besides animal consumption. Wastes from normal operation in the processing of soybeans can be adequately controlled in the plant so that the streams carry only a nominal organic load. Studies were conducted on a processing plant in Illinois and several facts were established. Accidental spills of molasses, condensed fish solubles (CFS), stabilized fats, and soybean oil introduce serious shock loads to receiving streams. This could be prevented by removing the softened sludge, fly ash, and soot. A holding tank prevents accidental discharge. Routing of wastewater through detention ponds can prevent overloading the stream. A pond was constructed which consisted of settling basins, a holding pond and an aeration spray system. A continuous monitoring program of the combined waste flow, treatment pond, and receiving stream has been carried out by sampling twice a week. Combined settling of the inorganic sludges provided satisfactory disposal and also made possible reuse of the clarified water. Data and charts supplement material and facts in this paper.

**64-0360**
Faith, W. L. Odor control in cattle feed yards. Journal of the Air Pollution Control Association, 14(11):459-460, Nov. 1964.

With the population explosion into the suburbs, cattle feed yards which were formerly miles from residential areas are now neighbors to housing developments. The odor from improperly operated yards has resulted in complaint and indignation by the new neighbors. The fattening of cattle is big business and still growing with 9 million cattle, each of which produce 26 lb of excreta, including 15 lb of urine per day. In California there are 500 feedlots with 3,500 to 32,000 head in the peak season. There are two types of odor: the odor from fresh manure is dissipated rapidly as the excreta cools and is not offensive. However, if the material does not dry out, highly odorous products are produced by putrefaction. The program at a 10,000 to 12,000 head feed yard with 70 acres of usable corral was built on good housekeeping. All piles of manure were removed; the corrals were scraped down to bare earth. The accumulations of hard packed anaerobic manure were removed from around mangers and water troughs. Pools of water or wet areas were avoided in the corrals. The manure was removed from the yards three times a year and the ground was scarified to promote aerobic conditions followed by spraying with 1 percent (200 lb per acre) of potassium permanganate solution. Odors which developed in dumps or ditches were controlled by the use of permanganate, either solid or in solution. The housing boom which brought residential areas into close proximity to feed lots has resulted in complaints of the odor, which is being minimized by controls.

**64-0361**
Feeding potential of reclaimed fecal residue. Compost Science, 4(4):32, Winter 1964.

Formerly, swine were used to salvage grain voided in cattle feces. Since grains are now ground for feeding, there is a decline in interest in this procedure. Nevertheless, feces from fullfed cattle contain appreciable amounts of undigested feed residue. Odors and flies are caused. Research is conducted to recover some of the fecal feed and to effectively dispose of organic residues voided by confined cattle.

**64-0362**
Fruit processing industry. Public Health Service Publication No. 952. Washington, U.S. Department of Health, Education, and Welfare, 1964. 15 p.

The nature and source of the liquid wastes are discussed and the inplant practices which are known to improve waste disposal situations are described. Practical procedures are discussed which may reduce the volume and the strength of the waste load and, thus, reduce total waste treatment costs. Water conservation in canning is discussed briefly in connection with its effect on waste problems. The principle methods of treatment generally recognized to be of value are outlined. A flow chart of fruit processing showing water use and sources of waste is given. The sources and estimated average volumes of waste waters from the processing steps in the canning of fruits are presented. Generally, it can be assumed that fruit canning produces a liquid waste approximately 10 times the strength of domestic sewage when expressed in terms of BOD. Each canning waste-treatment problem needs special study. Significant reductions can be made in the strength of fruit canning wastes by institution of waste-saving and waste-prevention practices. Fruit acids and sugars in the waste stimulate rapid and abundant microbial growth in the stream. The most common and expected pollution effect is depletion of the oxygen demand supply in the stream to a level at which fish life is killed. If utilization of oxygen is continued without replenishment, anaerobic decomposition of the waste begins with production of odors, discoloration of the stream, and other nuisance conditions. Treatment and disposal methods are discussed.

**64-0363**
Hart, S. A., and W. C. Fairbank. Disposal of perished poultry. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.213.

Despite the best operation and management of egg farms the mortality rate is 1 to 1¼ percent per month, a loss of 1 chicken per day for each 2,000 to 3,000 birds housed. These chickens may die from disease, cannibalism, heat, and other causes. Poultrymen get rid of dead birds in various ways, some of which create health hazards--for example, throwing the carcasses to vultures and skunks, or improper burial that pollutes underground water. Disposal of birds must be prompt, sanitary, efficient, and economical. The volume-weight relationship of dead chickens was determined. Disposal techniques may have to consider stabilizing the degradable meaty portion, with handling and long-term storage for the more inert bones and feathers. Rendering probably is the preferred method. Poultry pose both physical and economic burdens on rendering operations. Disposing of dead matter involves storage and processing. Burial, the oldest method for disposing of flesh, is truly storage, coupled with biodegradation. Burial pits or dry cesspools usually consist of a bored and covered dry well with a lidded top through which the dead bird is dropped. A second burial scheme is the heated septic tank, which is storage combined with accelerated biodegradation. Freezing dead birds stops putrefaction and is prompt, sanitary, and efficient. Chemical storage, for example, pickling in 2 or 3 percent formaldehyde solution, is cheaper than freezing. Most municipal dumps will accept dead birds for a fee. Bird maceration is not presently feasible. Proper incineration is a most satisfactory disposal technique, although more expensive and less sanitary. Enzymes to aid biodegradation are still of questionable value. Presently it costs between 0.6 to 5 cents each to dispose of dead chickens.

**64-0364**
Hart, S. A. Manure management in poultry waste disposal. Agricultural Engineering, 45(8):430, Aug. 1964.

Manure management was the principle subject at the Second National Symposium on Poultry Industry Waste Management held in May at the University of Nebraska. At the meeting a year ago, the emphasis was on outlining the overall problem of poultry waste, but this year the attention was confined to a consideration of the possible solutions. The aerobic and anaerobic degradation of organic wastes including manures wass discussed and related to the problem of stabilizing chicken manure. The discussion at the previous meeting had emphasized the desirability of manure lagoons. Further research indicated that only anaerobic lagoons hold much to offer as a method of handling the large volumes of organic waste from large-scale poultry farms. Even where land area is not limited, the availability of water could restrict the use of the aerobic lagoon. The methods of moving poultry manure from where it is defecated to the lagoon or other treatment facility was discussed by the group. The legal facets and the actual practice of dead bird disposal were discussed. The need for adequate environmental control by all segments of society, including agriculture, to protect our heritage of a bountiful and enjoyable place to live was stressed. The interest in the subject is evidenced by the attendance of 90 representatives of universities, government agencies, industry, and commercial agriculture.

**64-0365**
Hart, S. A. Processing agricultural wastes. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.168-174.

The manure wastes from cattle feedlots pose a problem typical of nearly all of agriculture's discard dilemma. Often this manure is spread on fallow land. This only transfers the problem from feedlot to field; it solves nothing. If the haul is distant, it may involve processing. Processing is the second of three steps in the management of agricultural wastes. Processing is preceded by collection, and is followed by utilization or disposal. The methods of manure processing as used today, and those which may offer some hopes for the future are reviewed. Storage, drying, composting, digestion, and lagoons in addition to other methods are discussed. The activated sludge process is aerobic degradation and stabilization in a water medium. Laboratory studies on the potential of this for highly diluted hog manure indicate that BOD reductions of 70 to 80 percent are readily obtainable. It is uneconomic to expect endogenous and complete stabilization, but activated sludge degradation of manure may have some potential. Cull and overripe fruits and vegetables left in the field, and all tree prunings, stubble, and unharvestable plant parts pose a difficult and expensive waste management problem. These wastes are generally disposed of in three ways: plowing into the soil; burning; and surface spreading. Agricultural wastes--both manures and field trash--are not wastes separate from the rest of the society's discards. Research is needed in the area of more complete utilization of organic matter through new processes and techniques.

**64-0366**
Hart, S. A. Sanitary engineering in agriculture. Compost Science, 4(4):11-15, Winter 1964.

There are four kinds of agricultural wastes: livestock manure, crop residues, dead animals, and chemical residues. Twenty-five percent of lifetime excretion of beef cattle is in the corral. Manure from birds is discharged in a concentrated area at a rapid rate. At a cost of 0.9 cent per lb for collection, a farmer would have to pay $200 per cow per year. The four steps in management of manure are: collection, processing, storing, and utilization or disposal. The farmer may wash out the barn or treat it like a solid Manure must be either stored in fly-tight containers or dried. Using fuel heat is expensive. California uses sun drying. Manure is too wet to be composted unless mixed with carbonaceous material. Digestion is too expensive. The anaerobic manure lagoon seems to be the best method of treatment since it needs minimal sludge removal. The major disposal of manure is returning it to the soil. Drying reduces weight and volume and concentrates fertilizer nutrients. But manure is not as good as chemical fertilizer. Manure can be used for vitamins, hormones, and drugs. It is used for fuel in India. Perishable fruits and vegetables, which are harvested in several pickings, rot and breed the fruit fly (Drosophila) which causes disease. When cereal stubble is incorporated into the soil, it ties up nutrients for the next year's crops; burning it causes air pollution. The future for dead animals is dim because synthetic detergents have reduced the market for fats.

**64-0367**
Hart, S. A. Thin spreading of slurried manures. Transactions of the American Society of Agricultural Engineers, 7(1):22-25, 28, 1964.

Manure disposal is a vexing problem of concentrated livestock farming, largely because manure is a prime breeding medium for flies and poses serious odor and sanitation problems. Manure is valuable as a soil additive or fertilizer, but it is difficult to stabilize. A spreading and drying scheme has proved a successful solution, possessing the potential for processing and increasing the utilization of manure. Manure from modern dairy, beef, and swine feedlots contains no bedding or litter. It averages 25 to 40 percent solids on a wet-weight basis. It is desirable to have manure as dry as possible to prevent fly breeding. The study determined that thin spreading, layer upon layer, day after day, could accomplish effective dyring. Spreading must be reduced in thickness as summer wanes, due to shorter daylenght, and generally lower temperatures. Odor were not an overwhelming obstacle in the study. Nitrogen loss did occur, but this is a reasonable sacrifice for the sanitary stabilization achieved. In the study itself, six 12 by 22 ft chicken manure plots and six identical dairy manure plots were each dosed with 47 cumulative layers of the appropriate manure slurry on a five-time per week schedule. Different thicknesses were tested. Chicken manure slurries averaged 19.8 percent total solids, and dairy averaged 13.7 percent. The land area required for cumulative layering was found to be large--less than 200 sq ft per cow and 1 sq ft per chicken. A future possibility lies in injecting manure slurries. Data discusses complete study results.

**64-0368**
Hart, S. A., and P. H. McGauhey. Wastes management in the food producing and processing industries. In Proceedings; Eleventh Pacific Northwest Industrial Waste Conference, Corvallis, Oreg. Sept. 1963. p.92-100.

The magnitude and nature of the waste disposal problem from the viewpoint of the food industry is discussed. Agriculture is the biggest producer of waste with 25 cu yd of manure and 8 tons of cull fruit and field trash produced per American family annually in the United States. Manure treatment is the most pressing problem. Presently most manure is placed on fields but its collection and spreading makes it more expensive than commerical fertilizers. Stalks, stems and leaves are generally plowed under. Tomato skins and seeds can serve as animal feeds, and fruit pits may be made into charcoal. The management of wastes is essential, and to ignore or make only half-efforts at effective disposal is to endanger our environment. Passing of the wastebasket from producer to consumer, or from farmer to processor is not suitable. The solution will come through education of the citizens, farmers, and producers to realize that coordination of waste disposal will yield a more satisfactory solution, that disposal must be financed, and research must be instituted into economical and feasible methods of community waste disposal.

**64-0369**
Howes, D. E. Programs and legislation for dead bird disposal. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.215-224.

The need for a complete security management program for the poultry industry based upon disease prevention is noted. The poultry industry has become increasingly dependent upon drugs and vaccines, resulting in poor management practices. Drugs are inadequate as the sole means of defense and should be used only for the treatment of specific diseases. Live virus vaccines have stimulated other diseases. The most important problem remaining is to prevent mechanical spread of diseases such as fowl typhoid, fowl cholera, infectious bronchitis, Newcastle disease, CRD, and fowl pox. Of primary importance is the fact that dead carcasses may contain disease agents for long periods. Thus, adequate and prompt destruction of carcasses must take place on the ground where death occurs. Legislation has been initiated in many states to assure proper disposal. Because every farm is endangered through disease-carrying vectors from diseased carcasses on a neighbor's farm, full participation is necessary if a plan of operation is to be effective. The education of producers to the total security management program is the function of the State Extension Service. Leadership by a strong industrial organization or federation of poultry organizations is needed. A suitable law providing for adequate disposal of dead birds on the premises, through use of disposal pits or incineration is suggested. Adequate time for an educational program to be carried out before the law is strictly enforced is necessary. The experience of Virginia in drafting a suitable law is drawn upon. A series of general meetings were held by Extension Poultry Specialists and Department of Agriculture personnel to explain the law and to discuss and evaluate disposal methods.

**64-0370**
Jeffrey, E. A., R. Ricketts, and W. C. Blackman. Aerobic and anaerobic digestion --characteristics of livestock wastes. University of Missouri Bulletin, Engineering Experimental Station, Engineering Series Bulleint No. 57, 65(2):1-105, Jan. 16, 1964.

This laboratory study was initiated with the purpose of determining the aerobic and anaerobic degestion characteristics of livestock wastes. Hog, cow, and sheep manure were digested anaerobically in bench-scale digesters. First stage BOD and oxidation rate constants were measured for these same wastes. A BOD and COD correlation was determined for each waste and the rate and degree of biodegradation of hog wastes in aeration tanks was investigated. The conclusions drawn in each phase of this study are correlated in the final chapter, and example calculations are presented for hog wastes. The quantity of waste required to treat the wastes, either aerobically or anaerobically, is considered in the final chapter, and it is shown to be a practical problem from the standpoint of the adequacy of many farm water supplies.

**64-0371**
Johnson, C. Liquid handling processes for poultry manure utilization. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.161-181.

An integrated system concept for liquid manure handling that has been operating for a year and five months with considerable success is described. The labor-reduction characteristics, sanitation control, and water recirculation aspects differentiate this poultry waste system from others to date. The Rolland Congdom farm in East Longmeadow, Massachusetts, is the site. The installation consists of conventional commercial cage units, arranged double-deck, upper tier back to back, and lower tier spaced about 8 in. apart. Droppings from the upper cage fall upon a 1/8 in. sheet of cement asbestos board, sloped toward the center. Droppings are scraped twice weekly from this board, from which they fall into the liquid trough below. The design of the concrete septic tank is described. The steps taken at the time of removal of 8 days accumulation of droppings under each line of cages are enumerated. This accumulation normally can be removed in 18 minutes. The estimated contracted cost for the installation would be about $1.00 per bird, which would be $0.247 per bird with over 7,000 birds, over a 10 year period, including a 3-time per year removal of the sludge from the tank. The 7,000 bird flock would yield 487 tons of fertilizer per year. Liquid manure retains more of the nitrogen, phosphorus, and potassium. The five E's of manure disposal systems are: Economics, Esthetics, Effectiveness, Efficiency, and Ease. A scale for qualitative evaluation of the latter is presented. The use of lagoons in areas where land values are high make it a prohibitive investment. The advantages of the liquid manure system described are pointed out.

**64-0372**
Ludington, D., and A. T. Sobel. Hydraulic collection of poultry wastes. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.115-135.

'Hydraulic collection of poultry manure' in the United States implies a pit of varying depth and width, with or without water added initially. The possibility of manure disposal in these pits altered their name to 'indoor lagoons.' The advantages of hydraulic collection are reduction in odors, the possibility of scheduled cleaning, more uniform yearly indoor temperatures, less labor requirements, and lower fly production. Some type of mechanical device for cleaning the hydraulic pits is a necessity, and this operation is described. For poultry manure to be moved mechanically, it must have a moisture content approaching 85 percent. This increase in liquid content is accomplished by the bacterial activity which destroys some of the solid matter, although this is not sufficient and supplemental water must be added either at the beginning of loading, during loading, or just before cleaning. The results of laboratory tests to determine the extent of bacterial activity in poultry manure are presented in graphs. Although about half of the solid matter is consumed, the total mass remaining in a pit which must be removed and disposed of is almost unchanged. Pit accumulation and design can be estimated by taking batch process data, which was projected to continuous feed process data, and relating it to an actual pit. Factors to be considered in estimating the time required for handling and spreading are: size and number of tanks for hauling, rapidity of loading, distance of hauls, mechanical reliability of equipment, availability of land, and number of birds. The biggest advantage of the hydraulic system is its flexibility in cleaning. Because of safety and the difficulty in cleaning, pits should be confined by walls and limited to 3 ft in depth. Because of the dilution required, more material must be handled when using a hydraulic system.

**64-0373**
Manure as fuel. Pacific Poultryman, 70(11):46, Nov. 1964.

A patent on a process for compressing broiler and laying house deep litter into briquettes to be used as fuel for heating broiler houses and greenhouses has been issued in England. Tests have shown that the heating value of these briquettes is 8,000 Btu per lb, according to Poultry Farmer and Packer. For wood, the Btu rating is 9,000; coal, 13,000; coke, 13,300; and oil, 19,000.

**64-0374**
Moisture level favoring little house flies. Pacific Poultryman, 70(11):32, Nov. 1964.

Studies conducted in California indicate that the little house fly (Fannia canicularis) is most likely to deposit its eggs in poultry manure that has about equal parts of water and dry manure. Droppings that are very wet or very dry have little attraction to the fly. When cracks developed in the mixture of 42.8 percent and 60 percent moisture, eggs were deposited in them.

**64-0375**
Morris, G. L. Extended aeration waste treatment plants. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.45-56.

The extended-aeration waste treatment process is a modification of the activated-sludge process, the principal differences being in the unit capacities, the load applied, and the aeration contact time. There is an absence of primary settling of waste in the extended-aeration process and the return of all settleable solids from the final settling tank to the aeration tank. Accumulation of solids within the system is an inherent characteristic of an extended-aeration plant, and the plant's efficiency is related to the amount of solids discharged in the effluent. Although the major application of the extended-aeration process has been to sanitary waste, the treatment of organic industrial wastes amenable to biological oxidation-reduction reactions is being considered. The design of extended-aeration plants is discussed. The principal information necessary for design of a plant is: (1) the total organic load expressed in terms of BOD and suspended solids; (2) the total waste volume to be treated with an evaluation of the minimum, maximum, and average flow correlated with the run-off period; (3) the degree of treatment necessary to satisfy the surrounding environment in terms of effluent discharge, air pollution, solids disposal, and aesthetic values. Typical design values are listed. The sludge-holding tank reduces the volatile fraction of excess sludge to make it suitable for sand drying beds, lagoons, and other disposal methods. Ponds for the storage of plant effluent for several days will affect reasonable solids control and maintain phytoplankton at a reasonable level. The use of slow sand filters is an effective effluent-polishing device. The advantages and disadvantages of extended-aeration plants are discussed, as is their use for processing industrial waste.

**64-0376**
Nicholas, R. C., K. E. H. Motawi, and J. L. Blaisdell. Cooling rates of individual fruit in air and in water. Michigan Agricultural Experiment Station Quarterly Bulletin, 47(1):51-64, Aug. 1964.

Cooling experiments included tunnel cooling, in which cold air at 31 to 32 F was the heat transfer medium for cooling apples of different sizes one at a time at different air velocities, and water cooling, in which apples were cooled in running water at 32 F at different water flow rates. The experimental cooling curves were compared with a theoretical model of heat transfer: heat loss from a sphere initially at uniform temperature to surroundings at constant temperature, and with a finite surface heat transfer coefficient. The experimental results, particularly with air cooling, suggest that the theoretical model, together with fundamental properties of the fruit and the medium such as thermal diffusivity, a thermal conductivity, and surface heat transfer coefficient, can be used to predict the cooling curve.

**64-0377**

No flies because birds use entire litter area. Pacific Poultryman, 70(11):41, Nov. 1964.

Flies are no problem for John L Kanst, Corcoran, California, who has a flock of 5,000 layers and also runs a dairy. His housing is of the deep litter type on concrete floors, and he allows about 21 per 4 sq ft of floor space per bird. The important point he makes is that every portion of the entire floor area is available to the birds at all times. There are no exposed areas of droppings, for the manure mixes with the litter, drawing the moisture out of the droppings and making them unattractive to flies.

**64-0378**

Ostrander, C. E. Hydraulic manure handling in laying houses. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.137-147.

The disposal of poultry manure has received much attention recently due to the high density laying operations on individual farms. Generally, 100 layers per day will produce 0.5 cu ft, 3.6 gal, or 25 to 30 lb of manure. One pound of fresh manure will be produced for each pound of feed used. Although there is no one system of handling poultry manure for all situations, the hydraulic system (collecting poultry manure in water pits) works very satisfactorily for many operations. Advantages of handling poultry manure in liquid form are: flexibility of cleaning, reduction of odors, reduction of labor in handling manure, less mechanization required, control of flies, and control of temperature in the poultry house. The hydraulic system with tanks 2 or more ft deep will operate 2 or more years before cleaning is required, under slat floors, and 6 months under stair-step cages. The tanks can be cleaned by gravity with the aid of a false end gate to encourage flowing. If the laying house is built on flat ground, the liquid manure must be pumped into the spreaders. This requires a minimum of a 3-in. pump. The hydraulic system reduces odors because the water in the tanks acts as a seal, trapping most of the gases. The pits or tanks, with a nearly flat bottom, should be 24 to 36 in. deep to allow for cleaning. Recommendations for adding the hydraulic system to remodeled houses are given. The hydraulic system, although often referred to as 'inside lagoons', does not operate under photosynthesis. There is little digestion, although some liquefaction takes place which aids in cleaning. The main disadvantage of the system is that it does not dispose of the manure itself.

**64-0379**

Palmer, L. M. What's new in manure disposal. Agricultural Engineering, 45(3):134-135, Mar. 1964.

A panel discussion held at the December 1963 meeting of the American Society of Agricultural Engineers is reported. Twelve different methods of manure disposal which were discussed included both the dry and wet methods. In the dry method the manure is dried out or incinerated as soon as possible to reduce the odor and fly problem. In the wet method, the manure is liquefied with water for ultimate disposal on crop land or in lagoons and it is this method which is getting the most attention from farmers. Poultrymen, hog producers, and dairy farmers are adapting their buildings to liquid manure systems. Poultrymen use water-filled tanks under their cages or slats. Completely slotted floors are the best type for pigs with provisions made to catch the dung in water. The problem with lagoons is the size required for aerobic conditions. For northern poultry farms, an acre of lagoon would be required for every 1,000 hogs for aerobic conditions. Doubt was expressed as to whether there was an aerobic livestock lagoon in the country, except as a research project. Anaerobic lagoons are feasible, but eventually the accumulated digested sludge must be disposed of. Incineration of manure may be the answer to the poultry waste problem. The manure has a high carbon content and evolves a large amount of heat which can be used to dry out manure with up to 60 percent moisture.

**64-0380**

Perry, C. A. Identification and control of odors from animal wastes. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.67-73.

Molds, fungi, and bacterial organisms which are present in all organic matter are responsible for producing odors. Decomposition takes place in aerobic and anaerobic conditions. In contrast to anaerobic bacteria, aerobic bacteria cause rapid decomposition and produce little odor. Anaerobic bacteria form foul, putrid, rotten-smelling by-products, which when concentrated into an air mass that moves over a populated urban area, cause numerous complaints. The City of Pomona brought a suit against two cattle feedlots, with nearly 20,000 cattle 3 to 5 miles from the edge of the residential area. A feedlot sanitation management program and a system to measure the results are outlined. In the spring of 1961 the two cattle feeders started removing a winter's accumulation of manure from the corral. Odor control chemicals were included. The program called for continuous manure removal, and reshaping the corral floors to keep them drained and dry. The subjective approach of measuring and identifying odors using the sense of smell was adopted. Three or four persons from each complaint area were enlisted. The old, hard-packed, deep manure layers were removed from the feedlots and the continuous cleanout and sanitary practices effected. The frequency of offensive odors coming from livestock operations greatly diminished. The management procedures were officially adopted as standards of operation and an ordinance governing cattle feedlot operations was avoided.

**64-0381**

Porges, R. Aerobic stabilization ponds. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.23-43.

Aerobic ponds operate with dissolved oxygen present, though oxygen must be absent in the bottom zone. The loading must be restricted so that the algae can liberate sufficient oxygen to permit aerobic decomposition. Organic materials are decomposed by bacteria to produce carbon dioxide, water, inert residues, and soluble nutrients. These nutrients supply the requirements for photosynthesis by algae. Loadings of up to 100 lb of BOD per acre per day are acceptable and even higher loadings may be possible where climatic conditions are suitable. Temperature affects the rates of decomposition and algal respiration; low temperatures reduce both rates. Where ice forms, ponds are effectively sealed and odors are associated with these anaerobic conditions, after the ice cover disappears. The addition of sodium nitrate or artificial aeration is suggested for an additional source of oxygen. Stabilization ponds should be located far from housing and water supplies. The shape, liquid depth, pond bottom, dikes, inlet, outlet, surface runoff, maintenance, and pond efficiencies are discussed. Data is supplied on the ponds in use for poultry waste treatment. One acre of an aerobic pond, where ice-cover does not persist will probably provide adequate treatment of manure wastes from 3,000 chickens if sufficient water is available. While stabilization ponds are not the answer in every case, they do provide another tool to assist in control of waste problems.

**64-0382**

Porges, R. Wastes from the poultry processing industry. Technical Report W62-3. Cincinnati, U.S. Public Health Service, 1962. 40 p.

A study of the poultry processing industry was undertaken because of the interest shown by regulatory agencies, industry, consulting engineers, and others concerned with water use and waste disposal. The average poultry processing plant is a modern, highly automatic establishment processing in the neighborhood of 50,000 birds per day. The various operations may be grouped under the general headings of receiving, killing, defeathering, evisceration and cutting, and packing. The blood from the killing station represents the waste of greatest pollutional significance. Defeathering and eviscerating operations account for a sizeable portion of the total plant waste load. The large majority of poultry establishments have flow-away systems consisting of flumes to receive wastes and wash waters. Recovery of blood, feathers, and offal for by-product salvage or separate disposal significantly reduces the pollutional load. Untreated poultry wastes have the following pollutional effects upon receiving streams: reduction of available oxygen, deposition of solids, addition of floating matter, and increase of coliform color, and inorganic mineral content. Poultry wastes most often are discharged to municipal treatment facilities. Various methods employed for treatment of poultry plant wastes are: primary settling, chemical treatment, trickling filters and the activated sludge process, stabilization ponds, and land irrigation.

**64-0383**
Portable scoop-sled for manure removal. Pacific Poultryman, 68(1):50-51, Jan. 1964.

Poultry manure is removed from below the group cages on the plant of Winlock Farms, Winlock, Washington, twice a year and is used by dairy farmers for their pasture and crop land. A 40-in. wide scoop-sled is used in the 5-ft wide pit below the 3 by 5 back-to-back group cages to bring the droppings out of the house, up through a 10 in. auger and onto a manure spreader or truck for hauling. The scoop-sled, the steel cable used to draw it back and forth, the cable and pulley anchoring device at one end, and the 5 horsepower electric motor at the other end are moved from one 240-ft long pit to the next one as the cleaning progresses. It takes about 600 hr per year to clean out manure from under 40,000 layers.

**64-0384**
Poultry manure superior fertilizer for tomatoes. Pacific Poultryman, 70(11):72, Nov. 1964.

Three groups of tomato, cabbage, and egg plants were used in a test conducted at Colorado State University. One group was fertilized with a chemical solution, another with fresh poultry manure, and the third with fermented poultry manure. At the end of 6 weeks, the plants grown on fermented manure had more leaves, heavier stalks, looked healthier, and showed better color. Tomatoes were producing more and larger fruit. Plants grown on fresh manure were not as vigorous, but were better than those in the chemical solution group.

**64-0385**
Pratelli, G. Swine housing trend in Italy. Agricultural Engineering, 45(11):616, Nov. 1964.

Italian swine houses and a brief note on the removal of feces are described. Water jets flush the manure to outlets and then to large underground masonry tanks.

**64-0386**
Questions litter use as animal feed. Pacific Poultryman, 70(11):50, Nov. 1964.

Bruce Poundstone, secretary of the Association of American Feed Control Officials, says that poultry house litter is not a satisfactory animal feed. Drugs administered to chickens in feed or water pass through the gut unchanged and remain in the litter. These drugs may be toxic to cattle and other livestock. In addition, poultry diseases can be carried to cattle unless the manure is sterilized.

**64-0387**
Reeder, N. Hog manure too valuable to waste. Nation's Agriculture, 39(5):14-15, May 1964.

Hog manure has a high value as fertilizer and is no more expensive to pump out and spread than it is to run off into a lagoon. The new hog house used with this idea has gutters under slotted flooring and is accessible from outside. The pumping system used must be built to withstand vacuum pressure.

**64-0388**
Riley, C. Dewatering poultry manure. Agriculture, 71(11):527-529, Nov. 1964.

In the dewatering of poultry manure, the problem is to convert an unpleasant, difficult-to-handle product, which cannot be given away, into a cake which can eventually be sold with the proper type of marketing. Normal industrial appliances do not dewater poultry manure well and the best results would be obtained by drying with heat. One thousand birds in cages will produce 2 tons of fresh manure a week at 76 percent moisture, which can be dried to 20 percent at a cost of $10 per ton for the dried material. In the operation of the drier it would be important to plan the system so that there is a constant input in order to balance the heat and airflow, and to control the load in a sensible manner. The system could be planned to empty a tier or block of cages at one time, or the drier could be operated at a fixed time from stored droppings. The nitrogen-phosphorus-potassium content has a value of $8 a ton compared to the cost of $10 a ton for the preparation of the dried material, which seems to store well in polythene bags. Dewatering of poultry manure is a relatively untried process. Plants do exist which can dewater poultry manure satisfactorily once the initial problems of handling are overcome. However, the process is not self-supporting and the question as to costs is still undecided.

**64-0389**

Rose, W. W., J. Chapman, and W. A. Mercer. Composting fruit waste solids. In Proceedings; Eleventh Pacific Northwest Industrial Waste Conference, Corvallis, Ore., 1963. p.32-50.

An initial study was made of the feasibility and requisite optimum conditions for satisfactory composting of fruit waste solids on a commercial basis. The procedure used 4 ft by 4 ft by 5¼ ft bins and a concrete pad for mixing and turning the compost. Five experiments were run. The first determined optimum weight rations of unpulverized peach solids to recycle compost. Initial moisture of 60 to 65 percent was recommended. The second showed that by grinding the peachwaste the time to form stable compost was cut in half. The third indicated that the initial low pH of the waste which slowed the beginning of the compost cycle, could be raised by adding 0.5 percent lime after 6 days which shortened the cycle by several days. The 4th showed that the initial addition of 0.5 percent lime decreased the time lag before pH rise from 9 to 3 days. The 5th showed the effects of nitrogen, nitrogen plus lime, and lime alone on fruit waste and sawdust. The nitrogen and lime gave the optimum results. Much study on the field level is still to be done. Detailed charts, tables, and analysis of the experiments are included. The feasibility of composting fruit wastes was shown.

**64-0390**

Sacca, G. Comparative bionomics in the genus Musca. Annual Review of Entomology, 9:341-358, 1964.

Various species are discussed. Sixty valid species are distributed in the Palearctic, Ethiopian, and Oriental zoogeographic regions. Flies' reproductive habits are described. Flies are more motile in warmer temperatures. Heaps of refuse provide flies with food and heat due to the fermentation process. Production of new individuals is huge there and on dung hills, due to the abundance of larval food made of organic residues of animal and vegetable origin which have long fermented, and are mixed with inert material that helps its aeration. When temperatures allow the winged insects to fly, the dumps are a source from which masses of adult flies move toward human dwellings. Musca may transmit diseases through: ingestion of pathogenic agent and deposition with fecal spots; swallowing the agent and deposition by vomit drops; or spreading through the external surface of the body. Flies feed on human feces which may contain viruses. Shigella dysenteriae has been found in the intestinal tract of flies. Epidemics of infant summer diarrhea are strongly affected by the presence of a large fly population. A house fly may be a carrier of tape worms, and nematodes whose eggs may adhere to the fly's legs. Many species of fungi and arthropods are parasites of flies. (Flies may act as true intermediate hosts.)

**64-0391**

Scheusener, P. E. Research needs in rural waste utilization. Agricultural Engineering, 45(9):492-495, 499, Sept. 1964.

Research scientists should devote more effort and original thought to the problems of rural waste disposal which range from feces to fungicides, from products of putrefaction to pesticides and from stream sediments to smog. The problem is not to find research projects in the disposal and utilization of agricultural waste, but to comprehend the wide scope of the total problem of rural-waste utilization. Five systems of organization are proposed: systems for human environment; systems for animal and wildlife environment; systems for plant environment; systems for processing agricultural products; and the social system. The proposed areas of research include: sampling methods and equipment for the air, soil, and water environment; identification of waste material; chemical, physical, and biological properties of rural waste products; engineering criteria for systems such as lagoons, irrigation operations, aerobic, anaerobic, etc.; establishment of 'safe levels' of wastes in the environment; and the reaction of wastes to the air, soil, and water environment, and their ultimate fate in those environments. Severe problems exist in large housing areas where no municipal sewers exists, and possible disposal fields are small and the soil is impervious. The performance equipment for handling animal excreta has not been determined. The long term security of man on this planet depends on how well the earth can accommodate both man and his wastes.

**64-0392**

Smith, S. M., and J. R. Miner. Stream pollution from feedlot runoff. Bulletin No. 2-1. Topeka, Kansas State Department of Health, Jan. 1964. 24 p.

The principle data were collected from three different streams. These are the Whitewater River near Potwin in the Walnut River Basin; the Cottonwood River near Emporia in the Neosho River Basin; and Fox Creek, a tributary of the Cottonwood River near Strong City. Additional information is given concerning pollution below a feedlot on Level Creek in Morris County in the headwaters of the Neosho River. Pollution from animal feedlots enters a stream with the surface runoff, and therefore discharges into the watercourse only as long as runoff occurs from that area. If a feedlot is designed so that no water passes over the lot except that which falls on it, the runoff ceases soon after the rainfall stops. Game fish are frequently trapped in the polluted waters. The most severe conditions do not occur at minimum flow, but after the stream begins to rise. The nature of the pollution in terms of several common water quality parameters is shown. The effect of the heavy organic pollution of the streams is reflected in the dissolved oxygen demand. Water quality parameters are presented for all of the areas. The investigation indicates that the runoff is characterized by a high BOD, high ammonia content, and heavy bacterial populations. The pollution is intermittent, since it occurs during the following runoff, but it causes a severe slugging effect on the stream. Serious depletion of the dissolved oxygen content of the stream may also occur.

**64-0393**

Stead, F. M. Social and legal implications of organic waste management. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.93-114.

After an historical overview of the development of environmental health in the United States, the present practices and problems relating to managing of solid waste are discussed. The systems approach is recommended for complex environmental problems. Our public health programs have developed primarily along lines of containment, which is out of step with today's environmental problems. Trends in public health are toward skillful management of the environment with both the consent and cooperation of the people, shifting from protection of people to protection and wise management of natural resources. Managing man's environment is actually a management of organic material, the surplus of which is organic wastes. The special characteristics of water and their relation to water uses are discussed. The varied uses of organic waste are mentioned along with their lack of management and appropriate conservation measures. The first step to be taken is to apply the aerobic stabilization process to convert putrescible and bulky organic wastes into a useable agricultural commodity. The transformation of present landfill operations into sites where all types of waste organic matter would be converted to compost is envisaged. The possible use of algae for producing food, and other technological innovations are noted. The environment will be increasingly man-dominated; organic material is probably man's greatest resource. The greatest good for all must be the criterion in balancing of equities between private enterprise and the public interest. Two major developments are: the establishment of a useable scale of values for the public interest, and the development of public decision-making machinery geographically matched to the public resource problems.

**64-0394**

Taiganides, E. P. Agricultural solid wastes. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.39-50.

The largest single problem in confinement production involves manure handling and disposal. The odor and fly nuisance of manure, the large quantities produced daily, the decline of manure as a competitive fertilizer, and the encroachment of urban areas on production units complicate the problem of livestock and poultry waste handling, treatment, and disposal. Little basic research has been done on methods of manure disposal. Virtually no information on manure management is found other than in the popular press. Technical papers based on research are nonexistent. Most of the feed ingredients of animals are excreted in the feces and urine. The amount of each feed constituent found in manure depends on the size and kind of animal, its condition, the environmental temperature, the feed conversion, and the water consumption of the animal. On the basis of these parameters, the quantity and composition of manure can be estimated theoretically. The average daily production and composition of farm animal manures is tabulated. Although manure disposal is perhaps the number one problem in livestock production, there are five other distinct sources of agricultural wastes whose handling and disposal can be just as problematic. These include human wastes from the rural population, crop residues, wastes from rural industries, agricultural chemical residues, and disposal of 30 million dead birds from poultry production units. No satisfactory method of farm wastes disposal has yet been advanced.

**64-0395**
Taiganides, E. P. Anaerobic digestion of poultry manure. World's Poultry Science Journal, 19(4):252-261, Oct.-Dec. 1963.

Anaerobic digestion as a method of treating farm poultry waste is discussed. Advantages of this method are the stabilization of the manure, removal of the nuisance and pollutional characteristics of manure, and the conservation of the fertilizer value of the manure. The major disadvantage is the high initial cost. On the basis of a volatile solids loading rate of 0.2 lb per day per cu ft and a 23 day detention period, the digester a capacity required is approximately 0.37 cu ft per hen. A 20,000 hen flock will require a digester with 7,400 cu ft capacity. The initial total cost of such a digester will range from $11,000 to $25,000; the income from using the available combustible gas produced at 5,400 cu ft per day could be $900 to $1,200 per year. Design considerations and cost figures based on manufactured sludge digestion equipment for different size digesters are discussed.

**64-0396**
Taiganides, E. P. Disposal of animal wastes. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.281-290.

The increased use of confinement production of farm animals has created a problem of waste disposal. Livestock and poultry confinement units with 10,000 to 30,000 population equivalents exist, and the number of such units is increasing. A study of the properties, handling, treatment, and final disposal of these animal wastes is presented. The physical and chemical properties of manures from swine, hens, turkeys, and cattle are listed in a table. Using that data the guide values for average daily manure production and composition are given in another table. The biological properties are described and the major fertilizing elements of the complete animal excrement per 1,000 lb of live animal weight are given for hens, hogs, and cattle in terms of lb per day and lb per yr. The elements included are: nitrogen, phosphorus, and potassium. The pounds of minor fertilizing nutrients (calcium, magnesium, sulfur, iron, zinc, boron, and copper) in 1,000 gal of fresh animal manure are given for hens, hogs, and cattle. The mechanical and hydraulic handling of these wastes is described. Physical treatment by storing or drying is reviewed. Drying, either natural or artificial, stabilizes the manure to some degree, reduces its weight, and lessens it attractiveness to flies. Dehydration, pelleting, and bagging of chicken manure might be profitable at $20 per ton if a market for large quantities could be developed. Chemical treatment is summarized. Biological treatment in lagoons is now being scientifically investigated at Iowa State University. There is at present no entirely satisfactory method for the disposal of farm wastes.

**64-0397**
Taiganides, E. P. Theoretical considerations of anaerobic lagoons for poultry wastes. In Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. University of Nebraska. p.251-261.

Lagoons for the treatment and disposal of farm animal wastes are not the panacea they are reputed to be by the farm press. They have not been found suitable for the treatment of animal manures because of their high land surface and water requirements. The design criteria for the reduction of the solid matter of manure have not been established. Generally, lagoons are judged by the following criteria: stabilization of the influent, control of odors, control of flies, and appearance. A properly functioning anaerobic lagoon should produce no vile odors. The main factors in anaerobic digestion are:

temperature, loading rate, solids concentration, detention period, volatile acid concentration, solid matter accumulation and scum formation, essential nutrients concentration, toxic substances, and pH. Some of the design criteria for anaerobic lagoons discussed are: size, water depth, inlet, outlet, shape, and location. The most advantageous time to start a lagoon is during the summer. Seeding procedures are discussed. Mixing aids the manure degradation process. Flies will not breed in an anaerobic lagoon unless a scum forms. Good bacteria husbandry dictates the continuous feeding of the lagoon, except when it is frozen. The value of anaerobic lagoons will be better defined after the end of experiments now in progress.

**64-0398**
Taiganides, E. P., et al. Properties and pumping characteristics of hog wastes. Transactions of the American Society of Agricultural Engineers, 7(2):123-124, 127, 129, 1964.

The largest problem resulting from hog confinement involves manure handling and disposal. The quantity and quality of manure are affected by hog size, food intake type and quantity, water intake quantity, and air temperature. When temperature averaged 80 F, the daily manure quantity was 2.44 lb per 100 lb of live weight. When temperature averaged 64 F, 5.1 lb per 100 lb of live weight were produced. The smaller quantity in summer was due to high evaporation losses of water. Since the pH ranges from 7.5 to 8.5, it is favorable for biological decomposition. Nitrogen was 7 percent of the total dry matter. Total solids composed 17 percent of the manure with volatile solids, 83 percent (dry basis), and 14 percent (wet basis). The production of BOD and COD was 0.35 lb per 100 lb of live weight daily, and 1.20 mg per mg of volatile matter, respectively. Copper added as an antibiotic to hog feed might be toxic to the bacterial population in the manure. The solid content of the manure pumped varied from 13 to 16 percent; no water or bedding was added. Auger and diaphragm tests disclosed that manure can be pumped with greater efficiency and less power consumption than water. The results of the pumping tests were presented graphically. Data on manure properties is given.

**64-0399**
University of Nebraska. Nebraska Center for Continuing Education. Proceedings; Second National Symposium on Poultry Industry Waste Management, Lincoln, May 19-20, 1964. 262 p.

Twenty-two papers were presented at the National Poultry Industry Waste Management Symposium held at Lincoln, Nebraska May 20, 1964. Topics discussed included: waste disposal concepts, principles and practices of aerobic treatment in waste disposal, odors and their control, anaerobic lagoons, social and legal implications of organic waste management, hydraulic collection of poultry waste, health aspects of poultry waste disposal, dead bird disposal methods--programs and legislation, social, legal, and economic considerations of animal production in urbanization.

**64-0400**
Vector control. In Training course environmental health survey, report and recommendations, Greater San Buenaventura, California. U.S. Public Health Service, Mar. 1964. p.43-46.

The potential extension in San Buenaventura, California, of suburban living and industrial organizations into agricultural areas necessitates planning and implementation of a well conceived vector control program. The past 10 years have revealed a multitude of vector-borne disease cases. Important vector sources in the area are bodies of water, animal manures, and refuse. No planned comprehensive control program exists for rodent control, fly and gnat control, and mosquito control. Budgets for vector control are nonexistent. No single agency keeps a complete record of nuisance complaints. Recommendations by the group of health service officials included a comprehensive survey of the extent and nature of the vector problems, establishment of a vector control program, giving responsibility for the operation of the vector control problem to the County Health Department, and employment of qualified vector control specialists by the County Health Department. Illustrations of the vector sources are contained within the report.

**64-0404**
Walsh, J. D. A survey of fly production in cattle feedlots in the San Joaquin Valley. California Vector Views, 11(6):33-39, June 1964.

During 1961 and 1962 an investigation was carried out to study the production of flies in the feed trough, feed apron, water trough, under the fence, and the corral surface of cattle feedlots in the San Joaquin Valley. Samples, approximately one-half pint each, were taken at each of the sites in the corral. It was decided that one to ten larvae per sample would be considered a light infestation. The house fly, Musca domestica, and the biting stable fly, Stomoxys calcitrans, were the most prevalent and important flies found to occur in the feedlots. The following conditions were found responsible for fly production: damp areas adjacent to the water troughs, individual droppings of which 64 percent were classified as heavy, accumulations of wet manure pushed under feed troughs, residues left in the feed trough, accumulations of manure under corral fences, and unsanitary horse stable conditions. No fly production was found on the concrete feed apron. Suggested fly control measures include: a 10 to 20 ft cement apron with a 1 ft slope away from the manger around the feed trough, the use of wire or cable instead of wooden fencing and reduction in the diameter of fence posts in the corral, and frequent removal of soiled bedding and damp manure and checking of watering troughs in horse stables.

**64-0402**

Wheatland, A. B., and B. J. Borne. Treatment of farm effluents. Chemistry and Industry, 2(9):357-362, Feb. 29, 1964.

The waste waters from farmyards arise chiefly from animals' housing, and include contaminated surface water from open yards and washings from milking parlors and dairies. The volume and strength of the wastes depend largely on the manner of housing. The volume of water used on dairies may range up to 30 gal per cow per day. All of this water does not require treatment as effluent. Data explains the volume and composition of waste waters from cowsheds and milking parlors. Dung contains a smaller proportion of organic matter readily broken down by biochemical action than urine. Relatively little water is used for washing down in piggeries, and piggery effluents are usually smaller in volume, but are much stronger than those from cowsheds. Because of the cost and difficulty of treatment, strong liquors, and, where possible, washings from cowsheds and similar buildings should preferably be irrigated on land where use can be made of the plant nutrients they contain. Availability of cheap chemical fertilizers gives the farmer little incentive to adopt this method of disposal. The increased use of water in the interest of hygiene, and the trend toward fewer and bigger herds, accentuate this problem. Disposal to irrigation ponds, discharge to sewers, separate biological or chemical treatment, septic tanks, and production of silage liquor represent other possible methods of effluent disposal. Sewer discharge is the least propitious of the various means, for resulting effluents usually have higher permanganate values than those resulting from treatment of domestic sewage.

## COMPOSTING

**64-0403**

Against composting. Public Cleansing, 54(4):864, Apr. 1964.

The United States, in general, is against composting because of unsuccessful attempts to clear economic hurdles. Americans consider their refuse poor raw material for compost.

**64-0404**

Ahrens, E. Effect of municipal composts on numerical development of azotobacteria. In International Research Group on Refuse Disposal (IRGRD) Information Bulletin No. 19. Washington, U.S. Department of Health Education, and Welfare, Dec. 1963. p.14-19

The effect of municipal refuse on azotobacteria was recently studied with respect of temperature effects, moisture content, and inhibitory materials. Temperature was found to have an adverse effect, destroying all the bacteria within three days after the composting process had begun. Therefore, the addition of these nitrogen-fixing organisms in the beginning of the process is useless. When the temperature of the piles was held constant at the maximum level for bacterial growth, it was noted that different piles had different effects on growth rate. Data for this test is given in a table and it can be concluded from it that these bacteria cannot maintain themselves in non-decomposed material. A sample of compost was then taken from one of these piles, allowed to compost for another 18 weeks at 25 C and tested for effects of moisture on the bacteria. The organisms had a higher survival rate in the damp material. Further attempts were made to show that inhibitory agents, but the results given showed inhibitory action is not a specific characteristic of municipal refuse.

**64-0405**

Black, R. J. Dutch use composting for one-third of trash. Refuse Removal Journal, 7(1):20, Jan. 1964.

Thirty percent of all refuse in the Netherlands is disposed of through composting, reflecting a European trend and contrasting with the failure of such attempts in America. The Dutch can easily sell the end products, agricultural compost and hot-bed manure, at the rate of $5.00 per ton. The City of Arnhem uses a Rasping System, which is highly efficient. Other cities use various kinds of composting systems. The Dutch government promotes composting by assisting cities in the marketing of the final product and by operating a fleet of railway cars to haul refuse.

**64-0406**

Black, R. J. Recent composting developments in the Netherlands. In American Public Works Association Yearbook 1963. Chicago, American Public Works Association. p.199-207.

Several composting plants in the Netherlands were visited. Arnhem's plant is one of the newest Rasping System installations. On an annual basis, approximately 26,000 tons of refuse are processed to produce 19,000 to 20,000 tons of compost and heating or hotbed manure. After separation, the refuse is discharged into the rasping machine (A Dorr-Oliver Refuse Treator), which reduces most of the refuse to particles which pass through 22 mm holes. After setting 4 to 6 weeks on brick pavement with built-in drains, a rubber-tired front end loader and a mobile conveyor-type windrow turner are used to mix the refuse, to add water, and to form the final windrows. After two months, the compost is ready for sale. Operating costs of the Arnhem Plant were reported to average $0.70 per capita served per year. The Dutch Government assists in the marketing of the compost. The Soest-Baarn composting plant uses continuous mechanical composting with positive airation. After sorting, salvage, and electromagnetic separation of ferrous metals, the refuse is loaded into a Dano Biostabilizer. The Dutch approach to composting is to figure that the cost of composting must be shared equally by the refuse producing cities and the compost users. No difficulties have been experienced in selling the compost at less than $5.00 per ton.

**64-0407**

Braun, R. Biological processes during composting, with special regard to hygiene. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 7 p.

The different composting processes which are caused by microorganisms can be divided into two groups, the processes which bring about a chemical, physical and biological transformation of the organic substance, and the processes which have an influence on pathogenic micro-organisms. The factors of special importance for the putrefaction process are: self-heating, aeration, humidity, microorganisms, and hygienization. Putrefaction is an exothermic process caused by micro-organisms. This self-heating caused by intense microbial activity has three phases: phase of rising temperature, thermophilic phase, and phase of diminishing temperature. The first phase is marked by very sudden proliferation of the mesophilic bacteria. The main stage of decomposition is completed by the cooling down phase. An aerobic putrefaction results not only in a longer and an incomplete decomposition and in the production of unpleasant odors, but also gives no assurance of the hygienization of the material. Sixty percent has been found to be the most favorable amount of humidity for the decomposition of refuse composts. Actinomyceta and fungi are the most active in the putrefaction of organic substance. The ratio between thermophilic and mesophilic bacteria rapidly increases when the temperature in the pile rises above 45 C, and this can be used to determine whether the heat generated in the compost has been sufficient. Sewage sludge can be transformed into hygienic material by treatment with temperatures over 100 C or by combustion. A mixture of refuse and sewage sludge given a hot putrefaction treatment with temperatures over 70 C will destroy all the pathogenic bacteria, but there is a considerable loss of valuable organic substances. Later, a lower temperature was found to be lethal. A combined effect of temperature and of the inhibitors, which are secretions of the organisms, leads to perfect disinfection of compost.

**64-0408**

Braun, R. Effect of compost on plants and soil. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 3 p.

Some of the recent research work of the effect of compost on plants and soil is summarized. Investigations at the Groningen Institute for Soil Fertility concluded that with most plants tested, the application of compost improves growth, increases productivity, and increases the organic content of a soil. If compost increases the humus contents of soils with less than the optimum by one unit, the average increase in productivity will be between 5 and 10 percent. It has been found that humus in the form of compost can correct extreme soil conditions. Forestry composts (dry leaves, bushes, peat, etc.) have a high carbon/nitrogen ratio and putrefy very slowly (2 to 3 years). Additions of fresh refuse which has been ground and putrefied may shorten the process to about 5 months. Refuse compost has been found to be of the greatest importance in viticulture as a substitute for organic fertilizers. It supplies the soil with humus-forming substances, thus improving the physical structure, and reducing erosion. Applications of compost have increased the crops of fruit trees and have improved the texture of heavy soils to such an extent that they could be used for horticulture. Recultivation in mining areas is possible through the use of compost.

**64-0409**

Buringh, P. Some new possibilities for the use of urban refuse compost in soil improvement. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962. p.1-12.

The possibility of adding fine grained organic matter or urban refuse compost to certain subsoils in order to stimulate and increase root development is emphasized. Urban refuse, stable manure, and other organic material added to the soil is almost always given to the top soil, the tilled layer. It does not, therefore, contribute to root development in deeper soil layers. The homogenization of the stratified subsoils by subsoiling, deep ploughing, and other mechanical means is a good starting point in the improvement of such soils. Various investigations have shown that this activity is usually not enough. Recent experiments in the Netherlands have shown that a mixing of the stratified subsoils can be combined with the addition of organic material, for example fine grained urban refuse compost or fine grained, specially treated, old sphagnum peat. Subsoil ploughing with a special type of plough, mixing some top soil or some peat layers with the sandy subsoil has a similar effect. The result of such measures is the distrubance of subsoil stratification, and, in addition, the initiation of favorable conditions for biological activity in the subsoil. This process, which is a combination of mechanical and biological homogenization of the subsoil, will enlarge the total volume of soil available for the plant root system. Experiments in young fruit plantations are promising. In the Netherlands, poor, sandy soil is intensively mixed to a great depth (often 1.5 m) and organic material including urban refuse is mixed to depth of approximately 0.080 m.

**64-0410**

Cairo refuse disposal. Surveyor and Municipal Engineer, 123(3740):55, Feb. 8, 1964.

A brief description is given for a pending investigation of Cairo's refuse disposal problems by a British composting team. An overall assessment is planned for converting Cairo's rubbish into organic fertilizer to boost Egypt's agricultural production and to reclaim desert wastes. A commercial scale plant recently shipped to the area is briefly described.

**64-0411**

Carlyle, R. E., and S. Brotonegoro. Composting refuse in Indonesia. Compost Science, 5(1):22-25, Spring 1964.

A composting experiment utilizing refuse from the city of Bogor, Java, Indonesia, is described. Freshly collected refuse was sorted to remove debris other than plant waste and stacked into four piles. The dimensions of each pile were 2 by 2 by 1½ m and its weight about 1.2 tons. The piles were turned by hand and moisture was maintained between 60 to 70 percent. The course of decomposition was followed by weekly determinations of pH and carbon-nitrogen ratio changes. The study also included a comparison of sheltered and non-sheltered composting, as well as the effect of adding nitrogen and phosphorus fertilizers. Tabulated and graphically illustrated data showed that: (1) erection of bamboo and palm leaf shelters over the composting piles was not beneficial under the climatic conditions of West Java; (2) the addition of nitrogen and phosphorus in the form of commercial fertilizers did not benefit the composting process. The raw waste apparently contained enough of these elements for normal decomposition; and (3) the waste can be composted in a maximum of 29 days, during which time the carbon-nitrogen ratio was reduced to between 1:10 and 1:15. The material was reduced in bulk by more than one-half and had a chocolate brown appearance and a texture consistent with good compost. Smaller cities can convert organic wastes into useful compost by using this cheap and simple method.

**64-0412**
Caspari, F. Capillary drying of mixtures of city refuse and sewage sludge. Compost Science, 5(2):21-23, Summer 1964.

A new process, capillary drying, converts city refuse and sewage sludge simultaneously and rapidly into an easy-to-handle and neat product. No odors develop during the process and the finished product has a variety of application possibilities. The process is described in detail and illustrated by a flow diagram. Partly dewatered sewage sludge and treated city refuse are mixed together, compressed by presses into briquettes up to approximately one-third of their original volume, and subjected to an instantaneous fungal growth. Within a short time the briquettes heat up to 50 to 70 C, thereby destroying the still-existing pathogenic bacteria and worm eggs, and the entire mixture is dried without creating any appreciable odors. By this process the concentrated and fermented substance of refuse and sludge can be stored in a very limited space, or can be piled up in the open for an indefinite period of time. The material can be reactivated by the addition of water and used for aerobic humidifying in compost heaps, and as mulch for surface covering. Untreatable rejects, which amount to 10 to 12 percent by weight, are burned.

**64-0413**
Cheadle and Gatley to compost the Simon way. Public Cleansing, 54(3):796-798, Mar. 1964.

A paper on the methods of refuse disposal prepared for the Cheadle and Gatley Urban District Council of England, and the resultant composting plant to be built by the Council are reported. The plant has three digestors and thorough dust extraction, and allows for easy expansion, and conversion to a pulverization unit.

**64-0414**
Clark, J. W. Composting domestic refuse in a 'home unit' . Compost Science, 4(4):16-17, Winter 1964.

Thermophilic microorganisms oxidize and stabilize organic material in composting. A home composting unit was constructed from a 55 gal steel oil drum equipped with a central rotating drum and hand crank. Holes were cut for ventilation and covered with copper screen. Using garbage from a family of four, grass cuttings, weeds and some paper, the composter will produce about two cu ft of good humus every 45 to 60 days. The large compartment is filled half-way with clippings. Garbage is distributed over the surface; the lid is closed and the crank rotated. This turning mixes the composting material with the new garbage and aerates the mixture. When the larger compartment is full, garbage is placed in the smaller compartment. If it is rotated too much, the wet material will ball up. Water is drained from the garbage and spread over the surface of the composting material. The composter will reach 145 F.

**64-0415**
Compost. Public Cleansing, 54(9):1174-1177, Sept. 1964.

A meeting of the Junior Members Discussion Group of the Institute of Public Cleansing held in Midlothian, Scotland, is reported. A speech was presented on the city's composting plant, which converts sewage sludge as well as refuse into compost. The group also discussed composting in general, touching on its development and the pros, cons, and the guidelines that governs its use.

**64-0416**
Composting. Public Cleansing, 54(4):858, Apr. 1964.

A conference called by the Community Council for Lancashire, discusses composting. The Council is attempting to encourage production of reliable, cheap, and effective means of improving the fertility of Lancashire gardens and lots. The City of Leicester's composting plant, which includes a furnace that burns non-compostable refuse is described.

**64-0417**
Composting plant for reclaiming refuse. Engineer, 217(5653):974, May 29, 1964.

The background of refuse disposal and composting problems in the United States, and the refuse reclamation process developed by Westinghouse and Naturizer, Inc. are described. The completely enclosed plants use a 6 day nuisance-free method that enables municipalities to dispose of trash and garbage rapidly, efficiently, and economically. The process is made up of the functions of receiving, salvage, preparation, digestion, and finishing. During the preparation, a pulverator moistens, and a grinder chews the refuse. The digester consists of six insulated cells. High sterilizing temperatures are produced by the decomposition of aerobic, thermophilic microorganisms. A rundown on the qualities and uses of the final compost is presented. The Westinghouse-Naturizer composting plant in San Fernando, California is described.

**64-0418**
Composting refuse and sewage sludge. Surveyor and Municipal Engineer, 124(3784):33, Dec. 12, 1964.

The combination of sewage sludge and town refuse in a composting plant at Leicester is discussed as an answer to the problem of a lack of dumping areas in proximity to towns. The quality of the finished compost is important and the rejection of cinders and glass is necessary. The water content of the compost must be kept around 55 percent to prevent an anaerobic nuisance or odor which requires that the sludge be partially dewatered. The Komline coil spring filter proved to be economical for dewatering the sludge. The reject rates which have been quoted as between 13 and 15 percent are important in the economics of composting. The value of the final product appears to be in doubt since the intangible claims as a 'soil conditioner' will have to be judged by crop yields. In Jersey, the authorities give away the compost. It is concluded if the material can be disposed of without producing unsightly abandoned dumps, the costs of the composting plant are justified.

**64-0419**
Composting treatment of town refuse and sewage sludge. Surveyor and Municipal Engineer, 124(3786):19, Dec. 26, 1964.

The discussion is given on a paper of L. P. Brunt who had described a method of mixing town refuse and sewage sludge to prepare a compost which provides a means of eliminating the refuse and also be a fertilizer source. Among the questions raised were: the problem of fine glass and metal which caused trouble to cattle; the use of P. V. C. containers; and the decrease in paper and vegetable matter in refuse. The question of a market for fertilizers made from composts of refuse/sludge mixtures was raised. Research Institutes commonly advise the use of artificial fertilizers and issue warnings about certain metals in compost such as zinc. Mr. Brunt replied to some of the queries as follows. Working on the basis of free compost, a composting plant is cheaper to install and run than an incinerator. Although the character of refuse is changing, the change is not expected to be rapid enough to affect any reasonable planning period.

**64-0420**
Davies, A. G. An appraisal of composting in England. Compost Science, 5(2):29-30, Summer 1964.

The economics of compost production are discussed. It is pointed out that a composting plant should not be expected to be financially self-sufficient. Direct cost comparisons between one method and another, or even where the same technique is adopted, have proved impossible because many factors and local circumstances have to be taken into account. The organic content of the refuse, the method of composting, the degree of pre-separation, the final quality of the compost and the income from sales, directly affect the costs involved. While the resulting end product of composting does not necessarily have to be sold, the income from such sales can be a welcome offset against production expenses. A stable end product of known and suitable formula and an appropriate system of marketing are two essentials for the successful sale of compost.

**64-0421**
Davies, A. G. An English analysis of composting circumstances. Public Cleansing, 54(4):362, Apr. 1964.

Government endorsed composting schemes from a good cross-section of plants are recommended. Economical considerations alone should not form the basis of whether or not to employ composting. The Fermascreen system is discussed.

**64-0422**
Davies, A. G. A further evaluation of compost. Public Cleansing, 54(3):783, Mar. 1964.

An excerpt from a speech on composting by the Manager of Cleansing of Edinburgh, Great Britain, at a meeting of the Institute of Public Cleansing is presented. The outlook on composting is shifting from that of a profit-producing enterprise to one of an efficient method of refuse treatment. Scientific investigation to evaluate the benefits of municipal compost to the land is needed. As land space decreases and incineration is prohibited by air control, composting, and pulverization are the only alternatives.

**64-0423**
Detroit Metropolitan Area Regional Planning Commission. Detroit planning group doubts practicality of composting processes. Refuse Removal Journal, 7(10):25, Oct. 1964.

Two basic methods of composting, the failure of a compost plant in Phoenix, Arizona, and the success of composting abroad are discussed. Composting has succeeded abroad because of the intense agricultural need for compost there. Composting is impractical for Detroit because the salvage and separation process would be too costly to develop and the end product could not find a ready market.

**64-0424**
Disposal system makes cash from trash. Engineering News-Record, 172:32, Mar. 26, 1964.

A completely enclosed refuse disposal system that reclaims saleable material designed by Westinghouse Electric, is described. Some of the advantages over presently used incinerators and sanitary landfill operations include: elimination of fill areas, odors, fires and smoke; reduction in haulage distance because plants can be located in center of collection areas; and reduction in costs through reclamation of marketable material (almost 100% of all domestic refuse can be converted into saleable products). The plant can receive most types of industrial, commercial, and residential refuse, with workmen at selection conveyors diverting salvageable material to storage hoppers in four categories: cardboard and paper; lightweight ferrous articles, rags, glass, plastic, and rubber; heavier ferrous articles; and aluminum articles. Non-salvageable material is thoroughly mixed and moistened in a rotating drum, and then flows into a grinder equipped with flails on a rotating shaft. As the material is ground, it is pushed into a digester with six cells and steel apron conveyors to move refuse into and through them. Aerobic thermophilic microorganisms, which digest the material, give off odorless carbon dioxide and water vapor. Since their metabolic processes produce the high temperatures at which they thrive, no outside source of heat is required. The resulting compost, which has less than 20 percent of the volume and 80 percent of the weight of incoming refuse, is stored in bulk or bagged for sale.

**64-0425**
Dried manure plants flourish. Compost Science, 5(1):31, Spring 1964.

A new manure dehydrating plant near the Forth Worth Stockyards is described. The manure is stockpiled in long rows where it is turned frequently to speed drying and decomposition. This greatly reduces odors and, at the same time, kills any young plants that may have begun to grow. The product is ground and shredded, moved through a gas-heated dehydrating drum, screened, sacked, weighed, and conveyed into boxcars or trucks. Three tons of manure produces about 2 tons of dehydrated plant food. The plant, which is automated and employs 18 to 20 people, can produce 100 tons a day during rush season. One of the disadvantages of setting up a manure dehydrating plant is that capital outlay is at least $100,000 before production can begin, and that national distribution is a necessity.

**64-0426**
Egyptians ponder Cairo compost plan. Refuse Removal Journal, 7(4):12, Apr. 1964.

To alleviate the disposal problem for Cairo's 3,500,000 population, a 5-year consultancy contract was placed with with Compost Engineers, Ltd. The aim of the study is to turn rubbish into organic fertilizer for agriculture and desert reclamation. A 1½ ton capacity test rig made in Britain was shipped Cairo, to aid in field trails and in making an overall assessment of the city's refuse disposal problem.

**64-0427**
Etherton, H. L. Oregon farmers save money by composting. Compost Science, 5(1):20-21, Spring 1964.

A method is described for the composting of screenings, a by-product of the seed cleaning mills. One such operation takes place on a 1,000 acres English Rye Grass farm in Lebanon, Oregon, which also contains a warehouse and seed cleaning mill. The dry screenings are dumped into the composting area the latter part of January. Several weeks of rainfall will introduce enough moisture to start the composting cycle. About the third week of March, the pile will be stirred by a specially constructed stirring machine. This automatic stirring machine was constructed from old automobile parts and scrap materials. The machine is powered by a 1938 Ford V-8 engine and has a hydraulic raising and lowering mechanism. The stirring will produce a heavy heat (170 F) in the pile, which will quickly kill all seed germination. The pile is stirred a second time about the middle of April, which completes the composting cycle. The farm composts 500 cu yd of material annually; the weight of the finished compost, which has a dark brown color and a strong earthy odor, is 1,200 to 1,500 lb per cu yd, depending on the moisture content. The finished compost, which is spread on the land to a depth of about 6 in., produces excellent crops without the use of any commercial fertilizer.

**64-0428**
Farkasdi, G. Experiments on the effects various additives on windrow composting of refuse and sludge. In International Research Group on Refuse Disposal (IRGRD). Information Bulletin No. 19. Washington, U.S. Department of Health Education, and Welfare, Dec. 1963. p.19-27.

Experiments were conducted to settle conflicting reports concerning the action of additives on windrow composting of refuse and sludge. These tests were to determine only whether or not the additive accelerated the process. Special attention was given to speed of temperature rise and to ammonia content. The effectiveness on fermentation cell process was not considered. Three additive accelerating agents were used: (1) 'Edafil,' (2) 'Proteg Oleo' and (3) 'Zusatze-Frankfurt.' The compost piles were of uniform dimensions and each was turned after the third, sixth and ninth weeks. After fourteen weeks, the piles were dismantled. It was concluded, after all tests had been run and tabulated, that the additives showed little if any effect.

**64-0429**
Fischer, F. Eight years of composting in Vienna. Compost Science, 5(2):28, Summer 1964.

The composting plant erected in Vienna in 1956 has been in continuous operation and turns out various grades of compost according to the rate of admixture of mineral nutrients. Capital and operating costs are kept at a minimum by an inexpensive production process, and due to its excellent properties the compost meets with a ready market. The plant is able to operate without any outside financial assistance, since the sale of the compost covers not only the running costs, but also the interest on, and repayment of, the credit raised for the equipment. Unfortunately the yearly amount of refuse handled by the plant is only 6 percent of the total refuse collected.

**64-0430**
Frangipane, E. Composting of solid city waste. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962. p.1-18.

The technique of processing garbage into compost is examined and the various major methods available at the present time are analyzed. Composting may be divided into two distinct treatment phases: mechanical treatment including sorting, homogenization, or crushing, and screening; and biological treatment involving anaerobic or aerobic processes. Natural composting methods include any method in which the biological phase develops after the arrangement of the waste material in heaps on adequate land prepared to this end, and the fermentation process is allowed to unfold naturally in the open until the waste material has reached the required degree of maturation. Mechanical treatment in crushers or by means of a rasp can follow or precede the phase of biological transformation. Artificial composting systems are subdivided into static and dynamic systems. Static systems provide that well sorted, screened, crushed, and homogenized material should be deposited in silos into which compressed air is injected, together with water or some other liquid in order to wetten the material if the humidity content should fall too low. Dynamic systems were developed to keep the material in constant movement, submitting it simultaneously to humidification and aeration in optimum proportions for a better and more active development of the aerobic fermentation process.

**64-0431**
Franz, M. Large-scale composting in the Soviet Union. Compost Science, 5(2):19-20, Summer 1964.

A review of three reports, recently translated from Russian government journals, shows the value of composted wastes in building soils and increasing crop yields. Corn, which received compost application in the winter time over snow, yielded crops equal to those obtained when the compost was applied in the spring. Other important facts cited are: (1) Composting on all types of soil resulted in an increase in harvest in more than 80 percent of 250 experiments carried out with winter wheat, rye, spring wheat, corn, and potatoes; and (2) Through composting, one ton of manure was made to do the work of three, and frequently did better. The superiority of compost over manure was indicated by the following data: compost containing less than 20 percent manure actually increased crop yield more than manure when tested on rye and winter wheat; use of compost caused fewer weeds, and poorer soils responded better to compost than did richer lands. Data presented further showed that seeding compost with benevolent fungus will offset the attacks of fusarium wilt. Compost with trichoderma is also active in the suppression of rhizoconia of the potato, fusariodal and anthracknoid withering of flax root mold in cereals, and black stalk in cabbage.

**64-0432**
Furlow, H. G., and H. A. Zollinger. Westinghouse enters composting field. Compost Science, 4(4):5-10, Winter 1964.

Open dumping and burning are unacceptable methods of disposal. Urbanization makes land for landfills expensive or unavailable. The refuse reclamation process developed by Naturizer, SACS, and Westinghouse, performs the functions of receiving, salvage, preparation, digestion, and finishing. Approximately 20 percent of incoming refuse can be removed and disposed of directly to markets. The salvage section consists of four successive selection conveyors for paper, glass, rags, plastics, and rubber; ferrous metals; and aluminum. The remaining material is mixed and moistened in a pulverator. Grinding is essential for fast decomposition. The digester provides a favorable environment for aerobic thermophilic microorganisms. The fine material is separated from the coarse. Material not decomposed is sent to a landfill. The humus is used for soil conditioning. The San Fernando plant uses special flail grinders. Reclamation plants use a small amount of land and are pollution free.

**64-0433**
Glathe, H. Microbiological processes in composting and their physical and chemical effects. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962. p.1-13.

The first and most important purpose of composting is to make a product unexceptionable from the sanitary point of view. The second purpose is to make a product that can be considered as a soil improvement item. The importance of mesophilic microorganisms in the creation of sanitary conditions is stressed. Whenever higher temperatures are required, self-heating must be promoted. The three stages of self-heating are: the stage of rises in temperature, the thermophilic or disinfecting stage, and the cooling stage. No clear data are available on the changes in types of microorganisms in composting. The importance of vaccines recommended for composting is as guides and activators of rotting processes. Orientation of the composting process differs very much according to the various procedures. In order to determine the methods and measures most safely leading to the aim proposed, ways and means must be available to assess in figures the results obtained, through these measures. The value to be determined is the degree of rotting or degree of maturation. Maturation is achieved only when the material is no longer in a position to produce heat; rotting, however, must be interrupted earlier so that the soil may receive the largest amount possible of organic substances. The last stage in rotting may occur in the soil itself.

**64-0434**
Gotaas, H. B. Compost-plant design and operation. In Solid waste disposal and municipal equipment 'rental'. New York, Buttenheim Publishing Corporation, June 1963. p.30-35.

Many fundamental factors affect the design of compost processing plants using biological methods. These include the proportion of organic matter and the carbon-nitrogen ratio of the refuse, size of refuse particles, moisture content of the refuse, temperature, aeration, pH, testing and quality control, fly and odor control, and pathogenic-organism and weed-seed destruction. Transportation costs are a major factor in determining the most satisfactory location of a plant. Economy of transportation relates not only to the raw refuse but also to marketing the finished product and salvable materials. Compost preparation involves grinding or shredding the material to a size suitable for composting. If sewage sludge is to be composted with refuse, it should be added either as a liquid or as a filter cake after the shredding of the refuse. The mixing of the sludge and refuse is by means of a rotating tube or by a rotating auger in a stationary tube. The aerobic decomposition and stabilization process may be either of two general methods: windrows or bins turned every few days to maintain aerobic conditions, or mechanized horizontal or vertical silo types of digesters in which the material moves mechanically more or less continuously to provide aeration.

**64-0435**
Hilkenbaumer, F. Experiences on the use of compost in fruit-culture. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962. p.1-13.

Experimental research was done on the effects of garbage sludge compost and its possible use in orchards. The effect of such compost on soils, on the physiological output, on growth, on yields and quality of the fruit was analyzed. The possible harmful effects of garbage sludge compost were analyzed in detail, namely, their lower damage limit on the various soils and for particular bases of fruit trees. The material used was the composted city compost of Baden-Baden from the Dano process. The humus fertilizers were compared with peat fertilizers, manure, and straw. In the course of three years, 100 tons per ha of garbage sludge compost induced higher yields of 13 to 76 kg per tree, as against mineral fertilizing with apples on strong developing clone bases in clay and sand. Peat fertilizer had a similar effect. In spite of repeated increases in harvests of apples and common cherries, there was also more growth of offshoots in most humus cases, as compared to mineral fertilizing only. In the drought year 1959 in the open, and during a drought period in container experiments, trees showed better foliage and less early leaf drop when the soil was in optimum condition of city compost and peat fertilizing. On the basis of current findings, additions of more than 100 tons per ha of garbage sludge compost are not required for a positive effect.

**64-0436**
Integrating sewage and refuse disposal at Leicester. Surveyor and Municipal Engineer, 124(3782):19-21, Nov. 28, 1964.

Leicester is planning on the installation of an integrated treatment of all of its sewage and refuse. Sludge from the sewage treatment works, together with the refuse will be hygienically converted into a useful agricultural compost. The refuse is sorted to remove the larger objects which are incinerated. Waste paper, rags, non-ferrous metals, and glass are taken to a salvage area for sorting and baling. A magnetic separator removes ferrous material. The sorted refuse and sludge filter cake are continuously rotated in a drum for 4 to 5 days during which time mechanical breakdown, surface disturbance, and aeration are continuous, and biological oxidation of the organic material takes place. The 130 F temperature which is lethal to pathogenic bacteria promotes a rapid decomposition of the material. The stabilized material is screened and some of the material is ground before the compost is stored for maturing. The works were designed to serve a community of 360,000. The estimated cost was £ 3,720,000. The principal trade wastes are from hosiery, footwear, light engineering, painting, textiles, chemical manufacturing, and gas plants. Composting was selected on the basis of cost.

**64-0437**
International Research Group on Refuse Disposal (IRGRD). Information Bulletins Nos. 19 and 20. Washington, U.S. Department of Health, Education, and Welfare, Dec. 1963 and May 1964. 67 p.

This group of papers is a publication of the International Research Group on Refuse Disposal (IRGRD). It is divided into two sections. The first contains six papers concerning the effects of the composting process on bacteria, mold fungi, and azotobacteria. Also presented are the effects of additives on compost. The second section contains articles on the analysis of various problems of municipal refuse removal including verterinary hygiene requirements and a description of a new machine for grinding bulky refuse. A report on the Eighth International Congress of Public Cleansing is also included. Each article has tables and graphs supporting its conclusions.

**64-0438**
Keller, P. Analysis and evaluation of solid waste with regard to composting. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962.

Garbage, sewage sludge, and industrial and trade wastes of an organic nature are analyzed with regard to their compostability, that is, whether they can be disintegrated aerobically by microorganisms and by a phase of higher temperature to form a product that is sanitary and without odor that may be deposited without concern. In the chemical analysis of domestic waste, sampling is important. An actual representative sample of garbage can only be taken once the waste to be composted is reduced in size. Composting trials are made either in small heaps 1.5 m high and 3 to 4 m long, or in plastic baskets with perforated walls. If in a composting trial, there is no rise or no adequate rise in temperature, proof is given that one or several factors determining the microbial disintegration are not as they should be. In garbage rich in paper, the periodical determination of cellulose contents also represents a useful method in the control of the rotting process. Analysis and evaluation of solid waste with regard to compost use involves evaluation of the quality of the compost, its chemical compostion, structure, and appearance. A general chemical analysis and various methods for composting trials are described in the appendices. The general analysis supplies information essentially on the relation between organic and inorganic substances, between total organic substances and organic substances that can be disintegrated, and between the latter and essential nutrients.

**64-0439**
Kick, H. Experiences on the use of compost for the recultivation of mining regions. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962. p.1-12.

Results obtained from experiments show that garbage composts, garbage-sludge composts, and also sewage sludge composts can be utilized for soil amelioration purposes, provided that the cost of transportation and the cost for the distribution of the material can be kept within acceptable limits. A thorough knowledge of the soil properties and of the properties and composition of the composts can be assessed with a fair degree of accuracy and give a good basis for possible utilization. The Rhineland coal areas may be supplied immediately with garbage compost in the amount of 300 tons per ha. This amount of compost corresponds to the yearly garbage produced by some 1,200 to 1,500 people. If sewage sludge alone is used without garbage, then it will not be difficult to use the amounts produced yearly by some 2,000 people. Up to the year 2,000, the area estimated necessary for mining purposes will be some 25,000 ha, and every year some 300 ha should be returned to agricultural purposes. The compost produced by some 450,000 people can be used every year on this surface. The experiences with garbage compost in vineyards on sloping ground have shown that such composts can be used advantageously to protect the slopes against any erosion damage and also to promote reforestation.

**64-0440**
Knoll, K. H. The influence of various composting processes on non-sporeforming pathogenic bacteria. In International Research Group on Refuse Disposal (IRGRD). Information Bulletin No. 19. Washington, U.S. Department of Health, Education, and Welfare, Dec. 1963. p.1-7.

It has been found through many years of experimentation that in composting, the raw material goes through several decomposition temperature zones. This is true no matter which process is used. These heat zones are responsible for the destruction of all foreign compost germs and substances. In the tests described, two different strains of typhoid were placed into composting material. One set of tests was run with the bacteria in sealed ampoules and in the second set, they were innoculated directly into the compost. This was repeated for each of the four different temperature zones as given in the tables. Resistance to the heat differed according to the strain of bacteria used and whether they were in ampoules or not. The exception was zone four, where temperatures ranged from 65 C and up. Here, all bacteria, regardless of any factors were destroyed within one day. Although high temperatures were shown to be the main destructive agent, microbial antogonisms aided the sterilization as shown by the shorter life of the strains exposed directly to the compost. Graphs and tables which give complete results are included.

**64-0441**
Krige, P. R. The utilization of municipal wastes. Council for Scientific and Industrial Research, 1964. 71 p.

As a result of towns having difficulties with respect to their dumping sites and concern being shown by the South African Soil Conservation Board, an experimental compost plant was erected in Pretoria. With the guidance of the Council for Scientific and Industrial Research (CSIR), a comprehensive study was made on the problem of utilizing urban wastes with particular attention given to the production of compost. This report presents their results. It includes their original plans, analysis of refuse to be handled, characteristics of composting, all pertinent chemical and biological information, field tests to be conducted and costs involved. Also presented are various tables and graphs as technical information.

**64-0442**
Krige, P. R. Salvaging procedure and marketing of salvaged items. In The utilization of municipal wastes. Council for Scientific and Industrial Research, 1964. p.31-33.

The salvaging procedure and the marketing of salvaged items from refuse collections in the city of Johannesburg, South Africa are discussed. Clean corrugated draft boxes are the only salvageable item on the refuse trucks. They may be recovered from the tipping hopper manually. Bottles and broken glass are extracted manually from the elevator belt at the tipping house. The first mesh screens out the 'fines' and dust which are used for refuse tip covering. The remaining three meshes screen out organic matter which make desirable soil builders. Bones are extracted manually from the horizontal picking belt and placed in large bins. Soiled paper is taken out at the same time and conveyed to the sorting floow. Rags are removed manually and stored. A magnetic separator extracts the ferrous metals and transports them to the baler. The remaining bulk is transported to the disposal site. Those products which are salvaged are sold to contractors: they make collections regularly. A table containing the breakdown of refuse collected over a two month period is included.

**64-0443**
Krige, P. R. Engineering aspects of mechanized composting with specific reference to the CSIR research plant. In The utilization of municipal wastes. Pretoria, S. Afr., Council for Scientific and Industrial Research, 1964. p.34-44.

In the CSIR research composting plant, mechanization does not extend beyond the biological stabilizer and the provision of rotary screens at the inlet and outlet ends of the main unit. As drawings show, rotary screens filter out 'fines' at the inlet end and grade the compost at the outlet end. From the screen, the refuse passes into bins and is raked into the paths of scoops. A large constantly rotating drum, the main unit for the primary biological stage, receives scooped refuse. The drum facilitates charge aeration by 24 air inlet nozzles. After time in the drum, the compost enters the outlet end of the screen. Due to experience with the plant, additional scoops and rakes were added, main gear box overheating was halted, moisture was prevented from entering the slip ring unit, and the jamming of the outlet door was stopped. Keeping air inlet nozzles clean, stopping drum 'climbing' , and protecting the stabilizer door, air nozzle cylinders, and end plates against excessive wear represent other improvements made. Recommendations were made for future designs. All bolts going through the drum should have the head on the drum's inside. Drums should possess a two-speed arrangement and contain precautions against dust formation. At least one manhole should be on the maximum circumference of the drums. Steps should be taken to prevent charge sliding over the shell of the drum and fittings. The girth rings' width, upon which the drum rolls, should be increased and motors placed at the outlet end of screens.

**64-0444**
Krige, P. R. Costs involved in the production of compost from municipal wastes. In The utilization of municipal wastes. Pretoria, S. Afr., Council for Scientific and Industrial Research, 1964. p.56-58.

The probable costs of manufacturing compost are analyzed and explanations for the data given are included. The influences of local circumstances and costs make impossible any general conclusion regarding the economics of composting municipal wastes. However, the likely trend of costs indicates that such composting can be economical, in comparison with dumping, if the composting plant is situated near the residential area. Compared with the costs of the research plant in Pretoria, savings can probably be made if more composting units are operated simultaneously. In order to arrive at comparable cost figures, all operations must be expressed in common units of time, distance, volume, or weight. Re-introduction of 'fines' after composting is also economically considered.

**64-0445**
Leatherhead compost. Public Cleansing, 54(1):650, Jan. 1964.

Compost produced from refuse in Leatherhead, England, has been marketed quite successfully. Sales have approached 3,000 tons and 6,500 bags in a 12-month period. Prices vary depending upon where they are consumed and how they are delivered. Chemical analysis of the compost revealed moisture, 38.30 percent; volatile matter, 23.50 precent; non-volatile matter, 38.20 percent; total nitrogen in dry solids, 0.88 percent; phosphoric acid in dry solids, 0.59 percent; potash in dry solids, 0.33 percent; and calcium in dry solids, 2.86 percent. The pH of the aqueous extract was found to be 6.90.

**64-0446**
Leicester, England builds compost plant. Compost Science, 5(1):14, Spring 1964.

A $10 million sewage disposal works and composting plant is nearing completion in Leicester, England. The plant is built for the combined disposal and treatment of the whole city's sewage and refuse. The layout and equipment of the plant is described in detail. Glass, paper, rags, and metals are removed from the household refuse in a salvage house before the refuse is fed to the rotating stabilizers. The salvage house will also contain for Komline-Sanderson vacumm coil filters which will dry the sludge received from the sludge digestion plant. The resulting cake is mixed with the household refuse for 4 days in Dano bio-stabilizers. Fermentation is encouraged by blowing air into the mass of refuse. The operation takes place at the temperature which is lethal to pathogenic bacteria and promotes the rapid decomposition of the material. After crushing and screening, and a period of maturing, a compost is produced.

**64-0447**
Leicester's sewage and composting plant. Public Works, 95(1):118, Jan. 1964.

An $11.2 million combination sewage and composting plant of Leicester, England, is described. It covers an area of 93 acres and has been designed to take a dry weather flow of 20.6 mgd from a population of 329,000, with provision for extensions to take 22.5 mgd. The incoming flow will pass through mechanically raked screens, disintegrators, and detritors. There are four digestion tanks, each tank fitted with a scraper and four mixing units which circulate the sludge through a water-heated jacket. Lagoons are provided to give some sludge storage capacity and provide for sludge thickening. Four vacuum coil filters dry the sludge received from the digestion plant, the resulting cake being mixed with the household refuse in Dano Bio-Stabilizers for four days. Fermentation is encouraged by blowing air into the mass of refuse.

**64-0448**
Martin, P. Plant pathology problems in refuse composting. In International Research Group on Refuse Disposal (IRGRD). Information Bulletin No. 19. Washington, U.S. Department of Health, Education, and Welfare, Dec. 1963. p.7-11.

The spread of disease organisms by composting is a distinct possibility because of the large amounts of vegetable and garden wastes in it. Because of this, a study has been conducted to determine the influence of composting on these bacterial and nematode pathogens. Plasmodiaphora brassicae (cabbage hernia), which is effective only in acid soils, can be checked by the addition of compost. Also affected by compost application in Heterobera rostochiensis, although in this case it is supposed that the compost increases the host plant's physiological resistance. Other diseases such as Olpidium brassicae and Rhizoctonia solani are destroyed by the high temperatures occurring during the composting process. Complete tabular results are included in the article. (An excerpt of this appears in Compost Science 6(3):23, Autumn-Winter 1966.)

# Composting

**64-0449**

National Canners Association Research Foundation. Composting fruit and vegetable refuse. Part II. Investigation of composting as a means for disposal of fruit waste solids. Washington, Aug. 1964. 51 p.

A program was initiated to develop and evaluate methods of handling and disposing of organic refuse giving particular attention to waste materials from canning and associated agricultural operations. Studies covering the period 1961 to 1963 are described. The results of the investigations indicated the potential feasibility of aerobic composting as a means of disposal for high-moisture fruit and vegetable wastes. Particularly encouraging was the absence of odor and fly problems. Municipal compost, rice hulls, and coffee grounds were mixed with the fruit wastes to absorb the moisture. Chemical additives such as lime and urea produced a more favorable environment for microbial growth during the compost process. Particular emphasis was given to the frequency with which fresh waste could be added to the compost piles. In the thermophilic range, the stabilization of fruit and vegetable wastes decelerated with subsequent waste additions. Future experiments will compare forced aeration with mechanical turning as means of maintaining conditions required for optimum growth of aerobic microorganisms. Since the feasibility of windrow composting was demonstrated, the mechanics of collecting, grinding, and distributing the wastes to the windrows will receive attention. An investigation concerned with the fate of the compost process on pesticides will be conducted.

**64-0450**

National Canners Association Research Foundation. Introduction. First-year program on bin-composting (1961). In Composting fruit and vegetable refuse. Part II. Investigation of composting as a means for disposal of fruit waste solids. Washington, Aug. 1964. p.1-10.

A survey of methods of handling organic refuse indicated that high rate aerobic composting might afford an acceptable method of treatment and utilization waste solids from the processing of fruits and vegetables. It was concluded that the high carbon content of fruit and vegetable wastes, present in the form of sugars and fruit acids, would be easily broken down and assimilated by suitable microorganisms. The composting experiments for 1961 were carried out in six-open-top, redwood bins. For each experiment the solid fruit wastes and a moisture-absorbent material were weighed before mixing. On the day following the initial filling of each bin, the compost was mixed and aerated by turning with a shovel. The compost was then turned each day for 5 days, and then on alternate days until the end of the cycle. Temperature measurements were made daily and grab samples were analyzed for carbon, nitrogen, phosphorus, potassium, moisture, and pH value. The results of these preliminary investigations on waste solids from the canning of apricots and cling peaches indicated that composting offered a feasible and esthetically acceptable method of disposal. Dry materials, such as municipal compost or rice hulls can be used to absorb the moisture from fruit wastes. The optimum initial moisture concentration was in the range of 60 to 65 percent. The maximum weight ratio of fruit to dry material was 250 lb of peach solids to 100 lb of municipal compost. Grinding the fruit shortened, by approximately 50 percent, the time required for stabilization of composted of ungrounded fruit. Reductions ranging up to 70 and 39 percent occurred in the initial weight and volume of the mixtures. Offensive odors did not develop.

**64-0451**

National Canners Association Research Foundation. Second-year program on bin-composting (1962). In Composting fruit and vegetable refuse. Part II. Investigation of composting as a means for disposal of fruit waste solids. Washington, Aug. 1964. p.11-30.

The fruit waste used in the second-year studies was from either apricot or peach canning. In the first experiment, apricot waste was passed through a Rietz Disintegrator. The ground material was layered into the bins with municipal compost serving as the moisture absorbent. Lime was added to the second bin on the 7th day of composting at the ratio of 1 lb to 200 lb of fruit waste mixture. Because the bin with added lime provided a better environment for bacterial growth, the temperature increased more rapidly than in the control bin. In the second experiment, lime was added into the mixture in an effort to create more optimum conditions for microbial activity and shorten the time required for waste stabilization. The beneficial effect of adding lime was demonstrated. An additional experiment was designed to show the effect of adding nitrogen in the form of urea to one lot of compost, urea and lime to a second, and lime only to a third. When lime or urea only was added, the pH rise was not as pronounced as that which occurred when the two chemicals were combined. Because urea supplied a readily available form of nitrogen, bacterial growth was stimulated, thereby stabilizing the waste at a faster rate than in the compost without urea. In the final experiment, rice hulls were used as the moisture-absorbent material, ground peaches as the waste source, and the bins were utilized in a manner to that of the previous experiment. Chemical analyses are given.

**64-0452**
National Canners Association Research Foundation. Windrow composting of fruit waste solids (1963). In Composting fruit and vegetable refuse. Part II. Investigation of composting as a means for disposal of fruit waste solids. Washington, Aug. 1964. p.31-40.

Field-scale experiments were conducted to evaluate windrowing as a composting method. Equipment was modified for the purpose of mixing, aerating, and turning the compost windrow. Windrows were turned each day, and samples were taken for routine pH and moisture determinations. To study the effect of periodic additions of fruit waste, four windrows were built using rice hulls as the moisture-absorbent material. The advantages of continually adding waste to the active compost mass were: that biological decomposition proceeded most rapidly at thermophilic temperatures, and that the removal of moisture by evaporation was maintained at its highest rate. Results showed an increase in ash, phosphorus, and potassium as waste was added to the windrows. In the final experiment, coffee grounds were used as the moisture-absorbent material. Approximately 5,000 lb of waste was added to 15 cu yd of grounds, then mixed and turned each day. Only one addition of waste was added to the windrow. The buffering capacity of the coffee grounds prevented a pronounced increase in pH. The coffee grounds apparently contained sufficient organic material to prolong microbial growth after the waste had been utilized. It was surmised that coffee grounds, after undergoing the initial process, would behave as did recycled sawdust in previous experiments.

**64-0453**
National Canners Association Research Foundation. Forced aeration compost study. In Composting fruit and vegetable refuse. Part II. Investigation of composting as a means for disposal of fruit waste solids. Washington, Aug. 1964. p.41-48.

Between canning seasons, small-scale experiments were conducted on forced aeration composting. An air duct was installed under the bottom floor of a specially constructed bin. The floor was drilled with holes to permit the air to penetrate through the compost mass. Rice hulls were used as the moisture-absorbent material. The waste was obtained from grocery stores and consisted largely of leafy vegetable wastes. During the experiment a total of 3,630 lb was added in 36 additions. The experiment was terminated after 71 days because the waste did not appear to be composting in a satisfactory manner. Temperature elevation did not follow additions of fresh waste. As the experiment progressed, the maximum temperature became lower and several attempts were made to revitalize the composting process. Waste additions were discontinued for several days in an effort to bring down the moisture content. Because of a heavy ammonia smell, the composting mass was aerated for long periods of time. This failed to cause any significant changes. Nutrients in the form of diammonium phosphate and dried yeast likewise failed to reactivate the process.

**64-0454**
New sewage works commissioned at Leicester. Surveyor and Municipal Engineer, 124(3773):25-27, Sept. 26, 1964.

The new 20 million gal daily sewage works in Leicester opened on Sept. 23, 1964, is described with special mention of the eventual use of the sludge from this plant being mixed with the city refuse to produce an agricultural compost. While the compost plant is expected to produce a marketable product, the main consideration in building the $1 million compost plant was the shortage of dumping sites in the area. The sorted refuse and waste and the sludge filter cake will be fermented at 130 F for 4 days with aeration.

**64-0455**
Niese, G. Tests for determining the rotting degree of waste compost using a self-generated heating capacity. Information sheet 17. Zurich, Switz., International Work Organization for Refuse Research, May 1963. 25 p.

The influence of progressive rotting on the self-generated heating capacity of waste composts was studied in the laboratory of the Institute for Agricultural Microbiology of the Justus-Liebig University in Geissen. The tests were carried out in Dewar containers, which were put in an incubator. The counting of germs was carried out according to the Koch method of pouring slabs at breeding temperatures of 25 C and 35 C. With increasing times of rotting, the maximum temperatures in the test decrease. This is true for test material obtained from stack compost, as well as for a mixture of waste and decayed sludge which had been stored for 4 weeks at different temperatures. It was also shown that there is a relationship between the maximum temperature rise during the test and the feed materials, which are used for the microorganisms. Estimates of the degree of rotting can be proposed from an examination of maximum temperatures reached.

**64-0456**
Nowak, W., A. Netzsch-Lehner, and L. Seibold. Effects of a waste-sludge compost on microorganisms. Staedtehygiene, 15(10):224-228, Oct. 1964.

Bacteriological investigations of the soil fertilized with a combination waste/sludge compost were made and compared with manured soil. To take account of the seasonal influences, four series of tests were conducted (in fall, late fall, spring, and in summer). The samples taken from the late fall test series showed primarily the existence of both rod-shaped bacteria and cocci. Fungi and various algae were also present. Bacteria and cocci were also found in the spring and summer test series. The summer test series showed the most intensive growth of microorganisms. The detailed results of these tests are compiled in five tables. A long-lasting improvement in the fertility of the soil treated with sludge/waste compost could be observed in some samples. This permits the conclusion that a certain fertility-promoting property can be ascribed in some instances to the sludge/waste compost. But no general conclusions can be drawn. The applicability of this kind of fertilizer must be decided in each individual case (Text-German)

**64-0457**
Obrist, W. Experiments on the effect on windrow composting of ground household refuse. In International Research Group on Refuse Disposal (IRGRD). Information Bulletin No. 19. Washington, U.S. Department of Health, Education, and Welfare, Dec. 1963. p.27-36.

The mixing in of various additives of bacterial, enzymatic, or chemical nature in refuse composting is tested to determine their value. The experiments were carried out in plastic bags of 30 kg capacity. Three different series were run, each consisting of a different refuse composition. Each series consisted of a control and five bags with the various additives. The following items were tabulated and presented: temperature, moisture content, and pH value, in all the series; germ count and cellulose activity in individual series. Each different additive had a slightly different effect. The microorganism additives showed a minor influence on temperature and germ counts. Organic nutrients, sugar, cellulose, and sludge, caused slightly stimulated decomposition. Inorganic nutrients caused a positive influence on decay characteristics and an increase in germ count and cellulose activity. In conclusion it was stated that microorganisms were practically useless, and organic and inorganic nutrients were only useful in refuse of one-sided composition.

**64-0458**
Process unit was marketable goods from garbage. Chemical Engineering, 71(8):90-92, Apr. 13, 1964.

A new refuse handling process is described, It can be operated in the heart of a city and minimizes disposal problems. The nuisance-free reclamation plan which has a capacity of 150 ton per day of refuse salvages valuable scrap, and turns the rest of the refuse into a compost which has value as a soil conditioner. The incoming refuse is sorted to remove large salvage items such as bed springs. About 20 percent of the incoming refuse is sorted for rags, paper, metals, rubber, plastics, and glass. The selection conveyors are elevated to allow the manual pickers to drop the sorted material to shredders, bailers, and containers below. The residue from the salvage operation is mixed and moistened in a rotating drum before being finely ground in an impact mill having flails fastened to a rotating shaft by chains. The digester consists of enclosed steel apron conveyors that travel 8 hr and are stationary for 16 hr. The decomposing material spends 6 days in the unit with a transfer from one conveyor to another every day and an additional grinding after the third day. The operating temperature is maintained under 160 F during the aerobic fermentation by ventilation. The final compost has less than 20 percent of the volume and 80 percent of the weight of the incoming refuse and can be used as a soil conditioner to complement chemical fertilizers. Chemical technology has contributed to the success of this refuse handling plant which has been in use for 9 months at San Fernando, California.

**64-0459**
Pulverising--a step towards compost. Surveyor and Municipal Engineer, 124(3776):33B, Oct. 17, 1964.

In the 'Fermascreen' composting plant, Compost Engineers, Ltd. claim that with the 'Seerdrum CE30' there is a 2 hr conversion process with automatic salvage and rejection separation. In a new unit under development, the crude refuse is pulverized in the refuse collection vehicle which reduces the volume to produce what the manufacturer describes as an attractive end product suited to nuisance-free landfill operations. The pulverizer should be of interest to authorities in need of land for controlled dumping.

**64-0460**
Removing glass fragments from compost. Compost Science, 5(1):21, Spring 1964.

The development of a new method for the removal of glass fragments from compost processed from garbage has been reported by Leon Zeldis of Tel Aviv, Israel. The method has been patented by the Israel Mining Industries laboratories in Haifa, and exploitation rights have been granted to the Industries Development Corporation.

**64-0461**
Research reports on composting. APWA [American Public Works Association] Reporter, 31(1):16, Jan. 1964.

The main objectives of the National Institute for Water Research Council for Scientific and Industrial Research, South Africa, were to reduce waste; pollution and to convert municipal waste into humus, economically. A pilot composting plant was established and the following conclusions were reached: (1) Refuse composition was not a critical factor; (2) Optimum moisture content improved the decomposition and the quality of the end product by increasing the nitrogen and phosphorus contents; (3) Artificial aeration must be adequate during stabilization; (4) The drum promoted rapid decomposition and produced a stabilized matter with no offensive odor; (5) Compost produced under controlled conditions would be safe to public health; The mechanized installation of CSIR produced a compost free of ascaris ova; and (6) Distance of haul and the number of units are the deciding factors regarding economics. It was recommended that further field tests assess the value of compost.

**64-0462**
Rodale, J. I. Can we clean the atmosphere. In Our poisoned earth and sky. Chap. 29. Emmaus, Pa., Rodale Books, Inc., 1964.

Air pollution and means of combating it are discussed. Six advantages of composting over incineration are listed: (1) It produces virtually no air pollution; (2) The organic materials are converted to a valuable end product; (3) Other useful materials, such as rags and metals, can be salvaged easily because of a composting plant's method operation; (4) Compost plants can be centrally located, reducing the hauling costs that are so often a drawback of the landfill method; (5) Dewatering sewage solids can be easily handled in a properly designed compost plant at about half the cost of conventional disposal methods in a modern sewage plant; (6) This method of sewage disposal also control to a large extent, one of the worst sources of water pollution.

**64-0463**
Sanford, C. F. Why Elmira, New York chose composting. Compost Science, 5(2):5-7, Summer 1964.

After reviewing the possibilities open to the City of Elmira for refuse disposal, the City Manager recommended composting as the method best suited to the needs of the community. Savings of as much as $30,000 per year are considered a possibility, and the objectionable pollution caused by burning of refuse would be eliminated. On the basis of the recommendation, the City Council authorized a contract on July 24, 1964, with National Organic Corporation of Atlanta, Georgia, for handling the City's garbage and rubbish waste through compost for a period of 20 years beginning November, 1965. Under the agreement, Elmira will furnish a minimum by 20,000 tons of refuse a year which will be processed by National Organic at a cost of $4.35 per ton. Estimated cost for the plant is $500,000.

**64-0464**
Shatzel, L. R. Composting methods at Kingston, Jamaica. Compost Science, 4(4):22-23, Winter 1964.

Kingston, Jamaica (population 420,000) has a composting installation owned by National Organic Corporation (NORCO). Refuse is dumped into a concrete pit. An agitated belt carries the refuse to the grinders. Liquids are drained off through holes in the belt into a sump pit. Glass, ceramic, and stone are freely ground. Metal items are reduced to approximately half-inch size. Material is discharged into a dump truck which transports the material to an adjacent field where it receives a bacterial inoculation. The matter is deposited in windrows for bacterial 'seeding'. Rate of flow is approximately 30 tons per hr. A temperature of 140 F is reached in 36 hr. An agitated screen sifts out the end product. Close to the sifting screen is an automatic bagging machine which packages the completed organic compost for sale as fertilizer and soil conditioner.

**64-0465**
Shuval, H. I. Composting costs in Israel. In Solid waste disposal and municipal equipment 'rental'. New York, Buttenheim Publishing Corporation, June 1963. p.57-63.

The cost of handling raw refuse in Israel's composting plants totals $4.50 per ton in Tel Aviv and $5.75 in Haifa. These are equal to or only slightly higher than some incineration costs. Some communities in the United States and other countries may find composting favorable economically if a minimal market for compost develops. An economic analysis of two Israeli composting plants is given. A good market for composted municipal refuse of high quality exists in Israel, and is predicted to continue in the future. In both plants, revenue from the sale of compost alone does not cover all production costs. If the income from salvage falls considerably, as it may do at times, the revenue from the municipal subsidy may be the deciding factor in whether the plants operate profitably or not. If a favorable market can be developed for the sale of compost, even at a nominal price, composting of municipal refuse may well become an economical solution for many American cities as it has already shown itself to be in Israel and other parts of the world.

**64-0466**
Sign agreement for plant construction. Refuse Removal Journal, 7(2):35, Feb. 1964.

National Organic Corporation (NORCO), Atlanta, Georgia, has entered into an agreement with the M. W. Kellogg Company, a subsidiary of Pullman Inc., naming the firm exclusive engineers and contractors for construction of National disposal plants throughout the world. NORCO has specialized in the development of composting as a means of waste disposal, using a mechanical and biochemical process for converting city garbage and refuse into a useful organic fertilizer.

**64-0467**
Spitzer, E. F. Composting--its role in European disposal--Part I. American City, 79(1):102, Oct. 1964.

The status of composting in Europe with emphasis on Rome, Vienna, and the Netherlands, particularly the Arnheim plant in the latter country is presented. Despite a ready market for compost, there is a trend toward incineration, which prevents composting plants from overproducing. Open dumps are also still widely used.

**64-0468**
Spohn, E. Waste elimination by composting. Staedtehygiene, 15(4):80-84, Apr. 1964.

Most compost made from domestic trash is not true compost but a mulch which is full capable of undergoing further aerobic decomposition. Ignorance of this fact has caused some damage in agriculture, and, consequently, some critical market situations for this mulch. On the other hand, compost from trash can replenish the badly needed humus of soils. In fact, trash and sewage are not wastes, but raw materials to be protected from destruction. The compost plant in Blaubeuren produces ripe compost from trash and sludge which is safe for sowing and planting. The worst kind of mulch comes from the Dano process. It must rest for several months before it can be used. A new process is utilized in Schweinfurt where trash and sludge are pressed into bricks. They heat up until the ripening process stops because of lack of humidity. Then the bricks can be safely piled and stored. They can be used as mulch or, after a further resting period with increased humidity when they completely decompose, can be used as compost. Rules a community should observe when contemplating acquiring a composting plant are: not waiting until all landfills are used up; advertising the compost well in advance to ensure a good market; obtaining help from the specialists; and keeping some dumping sites in reserve in case of emergency. (Text-German)

**64-0469**
Stickelberger, D. How the Caspari compost system works. Compost Science, 5(1):15-17, Spring 1964.

After a review of the various unsatisfactory methods employed for disposal of refuse and sludge, the Caspari compost system is described. The garbage is passed through a rasping machine and blended with fresh or processed dewatered sludge in the naturally obtained proportions. The blended mixture is briquetted under a pressure of 400 psi. The mass is reduced to one-third of the original volume, although no liquid leaks out during the process. The whole process is completed in 10 to 20 minutes, including the baling and storing by fork lift trucks in the curing room. Spontaneous fungus growth initiates a biological reaction which is not yet fully understood. Temperature rises rapidly up to 160 F inside the briquettes, thereby killing pathogenic germs and eggs of ascarides. The briquettes can be stored in the free air until they are needed for a variety of agricultrual uses. Advantages of this method are: no bad odors develop; manual labor is eliminated, since the whole process can be mechanized and automatically controlled; process time is cut from months to 20 minutes; handling and storage are simplified; and volume is reduced to one-third. A pilot plant process based on this method, the Brikollare process, has been developed at Schweinfurt, where the first full scale plant for 80,000 inhabitants will go into production this fall.

**64-0470**
Strauch, D. Garbage disposal from the veterinary health viewpoint. In Proceedings; Second International Congress, International Research Group of Refuse Disposal, Essen, Germany, May 22-25, 1962. p.17.

Compost, especially that made from combined sludge and garbage, may contain the pathogenic agents of epizootics. In Germany, whenever an epizootic occurs, the official veterinarian investigates the causes of the outbreak. If the outbreak is believed due to the use of a compost that is not free of pathogenic agents, the compost producer must prove that his method is safe. Besides pathogenic agents of zoonoses, there are also many specific agents pathogenic to animals in sewage and sludge. Reliable data are available on the fact that the generally practices mesophilic rotting of sludge does not kill all pathogenic agents. Experiments carried out in the Baden-Baden composting plant showed that the agents of psittacosis, paratyphoid fever, and swine erysipela are inactivated at the time of the first turning over of the compost heaps and can no longer be found alive in the garbage samples. This is also true for the bacillus of anthrax, but safe destruction of the anthrax bacillus calls for a degree of constant humidity of at least 55 percent in the original material. The addition of 'vaccines' did not seem to influence in any way the pathogenic agents contained in the compost. Examination of the conditions required for 'cold composting' showed that anthrax bacilie survived up to 251 days. The procedure, therefore, cannot disinfect a compost.

**64-0471**
Surber, E. Experiences on the use of compost in forestry. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962. p.1-8.

Various types of composts have been used in the last decades for soil amelioration in reforestation. In order to maintain at a high level the productivity of tree nurseries, the soil should be given a good structure that must be preserved over long years. The best results are obtained with well prepared and well putrified compost made essentially with organic material. In forestry, systematic composting will, of course, first of all use material from the forest itself. The material essentially used is leaves, twigs, peat green manuring, and straw. Such material with a wide C/N ratio (50:1) rots very slowly without adequate preparation. Trials have shown that such composting could be promoted and considerably shortened by mechanical fiber reduction on the original material, a reduction in the C/N ratio, and control and orientation of temperature and aeration. Adequate preparation and supervision can bring the rotting process down to 4 months. A variety of hammer mills can be used for mechanical fiber reduction. The reduction of the C/N ratio is obtained by adding nitrogen containing substances such as urine and ammonium sulphate. Increased aeration and temperature control is secured by repeated turning of the heaps. An addition of fresh garbage compost strongly promotes the rotting process. Mixed composts, with equal parts of leaves, twigs and fresh garbage compost give the best growth results. Mature garbage compost is essentially used for the planting of forest trees, as it is even better then mixed compost. Some data on sale possibilities in forestry in Switzerland are given.

**64-0472**
Thackrey, T. O. The coming struggle to breathe. Saturday Review, 47(41):23-25, 114, Oct. 10, 1964.

Pollution in the United States is examined. The biological waste reduction plan of Phoenix, Arizona, is studied. Examples of different types of pollution are cited and the solutions now in effect are given. The city of Phoenix, Arizona, was involved in one of the most promising waste disposal projects, involving a 20 year,, contract with a private firm for the operation of three biological waste reduction plants. The city paid the company a disposal rate of $1.25 per ton. Refuse was collected by dump trucks, dumped into a pit, and conveyed to a sorting house to get rid of non-compostable material. It was shredded, and finally fed into a large digesting drum where conditions for maximum bacterial action were controlled. Time of conversion was 24 to 30 hr. The compost was then sacked and sold. However, because of various difficulties, plant operation was discontinued.

**64-0473**
Tietjen, C. Conservation and field testing of compost. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.175-186.

While at present 'composting' ranks with incineration and sanitary landfilling as a method of refuse disposal in many countries, it must be realized that three groups of persons ordinarily participate in the composting of refuse: the producers of solid waste and the officials and boards responsible for providing sanitary collection and disposal facilities; the inventors and builders of compost processing equipment, and the compost producers; and the farmers and gardeners who are the expected buyers of compost products. The three most important requirements concerning compost quality are: an absence of substances that are injurious to man, crops, and soil; a high content of organic matter and plant nutrients; and a low content of useless substances like stones, slags, fragments, and plastics. The importance of the composition of refuse, moisture content, aeration, heating, and processing time have been demonstrated in numerous investigations. Some of the composting methods are illustrated and described with supporting data. The effects of crop yield are summarized in graphs. It is suggested that composting time in windrows or piles should be shortened as much as possible, by transferring organic decomposition process to plowed land by utilizing a method of sheet composting. The energy-releasing process for solid conservation must be utilized and crop production under a variety of ecological conditions must be learned.

**64-0474**
Toth, S. J. Agriculture uses for hardboard plugs. Compost Science, 5(2):24-28, Summer 1964.

The study was initiated to determine if it would be possible to prepare a satisfactory compost from hardboard plugs without shredding, and to determine if the product could be used as a mulching material. Three large batch composting studies and a laboratory composting study were conducted during the course of the investigation. In batch No. 1, fertilizer 5-10-10 was used as the nitrogen source, while in batch No. 2 a mixture of organic and inorganic nitrogen-containing material was used. Batch No. 3 utilized dried poultry manure in conjunction with the hardboard plugs. In the laboratory study, batch No. 2 compost was used. Their resulting composts were analyzed for nitrogen, potassium, and phosphorous. Nitrogen availability studies were also conducted. The results indicated that it was not possible to prepare a satisfactory compost from hardboard plugs due to the physical nature of the material, and that the nitrogen present in the various composts prepared was relatively unavailable for plant use. Comparisons were made between hardboard plugs, wheat straw, peat moss, and composted hardboard plugs to determine the value of the plugs as a mulch. Findings indicated that hardboard plugs and composted hardboard plugs were effective mulches for controlling weeds and for conserving soil moisture. They were more effective than peat or wheat straw when applied at a mulching depth of between 2 and 4 in. Hardboard plugs are not toxic to the plants and can be reused for mulching.

**64-0475**
Turner, W. A., and A. Sowerby. To compost or to burn. Public Cleansing, 54(5):909, May 1964.

A paper entitled 'Refuse disposal with special reference to composting and incineration', presented at a British Public Cleansing Institute held in Middlesbrough, England is discussed. Controlled tipping was treated as becoming a system of the past. Determining and comparing efficiencies and expenses of incineration and composting is not feasible, because of variation in materials, location of plants, variety of methods, screening, transportation, and ultimate deposition of the end products. A description of the 13 ton per day pilot plant composting operation at Middlesbrough, and an analysis of the compost are included. Demand for the compost in agriculture was questioned. Refuse disposal techniques may be established on the merits of the system for efficiently and sanitarily disposing of wastes, and not on the demand and value of end products on salvageable materials. Incineration using stainless-steel cones is presently being investigated in Germany.

**64-0476**
Turn-key composting plants. Public Works, 95(6):86, May 1964.

Westinghouse plans to build reclamation plants using a composting process that allows for rapid, efficient and economical disposal of trash. One plant has already been built in San Fernando, California, which has been successful. The compost product has been used as a soil conditioner.

**64-0477**
Von Klopotek, A. Mold fungi and refuse. In International Research Group on Refuse Disposal (IRGRD). Information Bulletin No. 19. Washington, U.S. Department of Health, Education, and Welfare, Dec. 1963. p.11-14.

The action and appearance of mold fungi during various composting processes was examined. The experimental results are included in two accompanying tables. Promoting agents were tried on compost during several trials, but their effects proved to be negligible because variation in composition, moisture content, and heat from pile to pile had a greater biological influence. Piles from Baden-Baden were compared with those from Bad Kreuznach and Heidelburg in the main body of the tests. It was found that increasing temperatures caused greater fungi growth. Also noted was a corresponding change in the composition of the flora. Up to 45 C Geotrichum increased by at 55 C the flora was solely Cladosporium. Between the 45 to 55 C increase the fungi count decreased because the organisms which account for the most growth, namely Geotricum and Mucorineen, could not survive the heat. After the pile was fully composted and temperature began dropping, fungi started to reappear, growing from the outside toward the middle. These late appearing fungi are mainly thermophilic. Final samples taken from the piles showed that the appearance of fungi was highly dependent on the material, moisture content, and temperature of the pile.

**64-0478**
Waste disposal in Israel. Wasser und Abwasser, 105(20):555, May 15, 1964.

According to a report by L. Watson, Haifa, Israel composts 60 to 70 percent of its entire city waste. The ministry of health permits only two methods of waste disposal: orderly dumping and composting. The composting plants are in private hands but receive subsidies from the municipalities. The amount of the subsidies is coupled with the cost of living. For every cu m of compost sold a small charge is collected from the compost producer which goes into a fund for financing research in the field of waste disposal. (Text-German)

**64-0479**
West Indies compost operation supplies island plantations. Refuse Removal Journal, 7(3):20, Mar. 1964.

The end material of a composting plant in Kingston on the island of Jamaica is valuable as a natural fertilizer and soil rebuilder. The refuse is ground, treated with bacteria to accelerate deterioration, and then the product is composted. The compost pile develops an interior temperature up to 160 degrees, which in effect, pasteurizes the rubbish, in addition to hastening decomposition. The plant and the composting operation are described in detail.

**64-0480**
Westinghouse offers to build plants to solve refuse disposal problem. Western City Magazine, 40(3):46, Mar. 1964.

The new Westinghouse Electric Corporation's refuse reclamation plant is completely enclosed. There are no odors, fires, rodents or smoke, and it prevents air and water pollution. The pulverator reduces the size of the material and mixes it with water to quicken bacterial action. After grindings, it is sent to the first of six digester cells for decomposition. These six cells, arranged in two tiers of three cells each, brings about decomposition in days instead of weeks.

**64-0481**

Weststrate, W. A. G. Composting of city refuse. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.136-147.

A brief description of each of the four systems of composting is given: (1) the Van Maanen system; (2) the Rasping system; (3) the Dano system; and (4) the Hammermill system. The fermentation processes and the uses of compost are discussed. The main problem is how municipal refuse can be processed to reduce the amount of unworkable residue, without detracting from the quality of the compost. The field of fermentation has been widely researched. Investigators have proven that disease germs cannot survive the long period during which a temperature of 50 to 80 C is maintained. Compost is considered harmless from the hygienic point of view, provided it has been subjected to fermentation at elevated temperatures. This is particularly significant in the case of bacteria present in sewage sludge when it is mixed with refuse. Therefore, sewage sludge should always be added to the refuse before the fermentation process takes place. To be sure that pathogens are destroyed, the temperatures during fermentation should be raised. In the case of aerobic fermentation, there is always a rise in temperature; in the case of anaerobic fermentation the temperature rises, but very little. It is important to study the use of compost as manure and as a means of improving the soil. If the compost is not put to use, all efforts to produce it are of no avail. The only remaining possibility is to use the compost as cover material on a sanitary landfill.

**64-0482**

Wicker, W. J. A new look at refuse composting. Public Works, 95(10):131, Oct. 1964.

The operation of the composting plant in Kingston, Jamaica is described. The plant is successful in Jamaica and would be successful in the United States.

**64-0483**

Wiley, J. S. A report on three manure composting plants. Compost Science, 5(1):15-16, Summer 1964.

Three manure composting plants are described. A windrow composting plant treats a mixture of feedlot manure from 5,500 steers, and meat packing wastes, including blood. The windrows are about 5 ft high and contain approximately 1 ton of wastes per 1⅓ ft of length. Windrows are turned six times during the 6 week composting period. The resulting compost is processed through a ¾ in. vibrating screen, a 3/16 in. rotary drum screen, a miller-type impact mill, and a concurrent, single-pass, rotary drum drier. Only minor fly problems were encountered by the use of this method. Composting of chicken manure by rotary drum and windrow composting is the method of the second plant. During experimental runs it was learned that the moisture content of chicken manure must be lower, in the range of 35 to 40 percent, than for composting other wastes. Addition of carbonaceous wastes at a 1:1 ratio improved the structure of the chicken manure for aerobic composting and minimized the loss of moisture and ammonia. A Eweson Rotary Drum Composter was under test for composting straight chicken manure. Each drum holds about 150 tons, is divided into three compartments, and has a retention time of 6 days. Air is blown into the discharge end of the drum. Mud-ball formation was encountered at a moisture content of 38 to 42 percent. As of February 1964, no satisfactory runs had been made in the rotary drum unit. The need for addition of dry, low-nitrogen wastes is evident.

**64-0484**

World's largest composting plant for Santo Domingo. Surveyor and Municipal Engineer, 123(3752):58, May 2, 1964.

The world's largest composting plant with a capacity of 800 tons a day is planned for the City of Santo Domingo in the Dominican Republic. The capacity figures are indicated. The plant will handle 80 tons of unsegregated refuse an hour for 10 hr per day. The plant operator, National Organic Corp. of Atlanta, Georgia, operates a plant in Kingston, Jamaica, and sells the end-product as an organic fertilizer. The City of Santo Domingo has contracted to provide a minimum of 100,000 tons of refuse a year over a 20-year period, and to pay a dumping charge to cover the operating costs. The plant will cost $1,300,000 and will be built on a 20 acre site provided by the city.

# REDUCTION

**64-0485**
Bretzke, D. J. You must have a garbage-disposal unit. American City, 79(6):177, June 1964.

Thornton, Colorado, has passed ordinances requiring garbage disposal units in all homes, and 99 percent of the city's 3,000 homes now have them. The ordinances and their effect on the community are reviewed.

**64-0486**
Crushing refuse with the Gorator. Brennstoff-Waerme-Kraft, 16(8):404-405, Aug. 1964.

The inclined disk machine or Gorator consists of a cylinder in which a disk rotating at high speed and inclined towards the shaft crushes, mixes, and kneads the supplied refuse. Besides solid material like wood, small metal parts, and bottles, it also accepts fibrous, pasty, and viscous material. Gorators with 2.5 m diameter and 3,000 hp are being developed. Gorators are used to homogenize raw material in the chemical and paper industry and to treat refuse in waste burning facilities. (Text-German)

**64-0487**
Crusher saves space. Factory, 122(4):169, Apr. 1964.

Crushing rejected tin cans is recommended to save space and manpower. A high speed can filling line kicks out punctured, dented cans and their contents flow into an adjacent 55 gal drum. An operator then throws the empty can into a combination can and bottle crusher. Crushed cans require less space to store, and only one trip to the dump is necessary per week.

**64-0488**
Kummer, F. A new machine for grinding bulky refuse. In International Research Groups on Refuse Disposal (IRGRD). Information Bulletin No. 20. Washington, U.S. Department of Health. Education, and Welfare, May 1964. p.56-59.

The Firma von Roll AG, Zurich, decided several years ago to build a new machine. They needed a machine made principally for shredding bulk refuse and which met rigid requirements. The requirement of ease of charging was solved by a large horizontal opening which requires no special feeding arrangement. The cutting process was done by durable and exchangeable knives each of which has four cutting edges. These shred all bulky material. The third requirement of minimum power was taken care of by special construction details. A very practical hydraulic drive and a power intake of 37 kw were two of these details. The machine was equipped with automatic controls which permit the elimination of labor except for the crane operator for charging the machine. The machine was installed on a building-block foundation in order to lower costs and to satisfy the widest range of customers. This machine for shredding is very suitable for communities which still dump their refuse. Illustrations of the apparatus are contained in the article.

**64-0489**
Neidl, G. Newer methods for refuse treatment. Wasser, Luft und Betrieb, 8(12):734-738, Dec. 1964.

A new method of homogenizing all kinds of refuse, such as litter, carcasses, digested sludge, fuller's earth from oil refineries, waste from large chemical plants, articles of clothing, dishes, leather goods, etc. by means of a gorator is described. Gorators have enormously high shearing speeds (30 to 40 m per sec and more) and homogenize the refuse into a stable but pliable consistency. Several gorators are described and illustrated. They can operate at temperatures as high as 400 to 600 C, and can be used as mixers, homogenizers, and pumps. Gorators on the market at the present time range in size from 30 mm diameter to 1.5 m diameter with a motor strength of 320 p.s. Larger machines of 2.5 m diameter are expected in production during 1965 to 1967. These machines will be able to crush and homogenize sofas, automobiles, etc. It is possible to install a gorator in the cellar of a large building under the refuse chute. The resulting homogenized refuse then goes into the town sewage system. The durability of the gorators has been very good; constant operation of 3,000 to 5,000 hr is no exception. A complete refuse-treating plant utilizing a gorator is described and illustrated. The treated refuse can be used as fuel or compost. Experiments are in progress on combining treated refuse with cement, water, and plastic to produce building stones. The cost of the plant and the personnel necessary to operate it are discussed. (Text-German)

**64-0490**
Oates, E. T. Refuse disposal--why pulverization? Public Cleansing, 54(10):1201, Oct. 1964.

The Chief Public Health Inspector and Public Cleansing Office of Worthing, England, outline the reasons why refuse should be pulverized before tipped. Pulverized refuse is odor-free, more aesthetic, more sanitary, denser (thereby prolonging the life of the tip), economical, and unnecessary to cover. The author, whose city tips pulverized refuse, also answers often asked questions on pulverization and lists firms that manufacture pulverizing units.

**64-0491**
Pulverization. Public Cleansing, 54(7):1006, July 1964.

The meeting of the Midland Center of the Institute of Public Health, at which R. H. Smedley of Stafford, England, presented a paper entitled 'Pulverization', is reported. Incineration and controlled tipping are obsolete. Reasons why Stafford chose pulverization are given. The unit consists of rotary drum screen with opposite rotation knives. Composting is the hope of refuse disposal. In the discussion afterwards it was agreed that modern incineration and controlled tipping could be operated efficiently and sanitarily.

**64-0492**
Watson, K. S. Solving community garbage problems by the use of disposers. Western City, 40(4):36-39, Apr. 1964.

Some 64 cities have ordinances requiring the use of disposers. In Los Angeles, due to the use of disposers and frozen and prepackaged foods, the average of garbage collected totalled a decrease of 0.25 lb between the years 1951 to 1960. Aurora was chosen as a test city for the use of disposers for a 5-year period ending 1962. The use of disposers created no serious problems in the sewage system. BOD and suspended solids were increased by 20 percent and 25 percent respectively by persons using disposers over those who did not use them. Since there was some question about the exact load contributed by disposers, the General Electric Company agreed to fabricate enough prototypes to make another analysis. Therefore Hoffman Heights was consigned 338 portable disposers. This analysis showed the contribution per individual per day to be 0.052 lb/BOD and 0.064 lb of suspended solids. These figures will help in the design of new sewer systems and treatment plants. The tables included in this article concerned the following: (1) Los Angeles area communities with disposer ordinances; (2) average wastewater characteristics and treatment costs; (3) Denver area communities with disposer ordinances; (4) average wastewater characteristics and treatment costs at Aurora; and (5) average load contributed by disposers in Aurora.

## INCINERATION

**64-0493**
Air pollution. In Environmental health survey, Wayne Township, New Jersey. Cincinnati, U.S. Public Health Service, July 1964. p.35-40.

The Wayne Township zoning ordinance specifically prohibits industry commonly associated with air pollution. Disposal of garbage by incineration is also prohibited by an ordinance. The Agricultural Extension Service reports that air pollution attributable to automobile exhaust has affected vegetable and flower farms. Existing ordinances will not protect Wayne from sources outside the community. It is recommended that existing statutes and ordinances to control air pollution in Wayne be more strictly enforced. Wayne should prohibit all open burning and institute an active program for the control of noxious weeds.

**64-0494**
Benline, A. J. Air pollution from the municipality and the home and its control. In Proceedings; National Air Pollution

Conference, Washington, Dec. 10-12, 1962. Public Health Service Publication No. 1022. 1963. p. 103-105.

Air pollution attributable to homes originates with two basic operations. These are the operation of heating plants and of refuse disposal or incineration equipment. Minor air pollution problems result from poor placement of ventilators in buildings with basement garages and from the discharge of lint, odors, and steam from such domestic devices as domestic clothes dryers or air conditioners. There is also the problem of dust emissions encountered during the construction or demolition of residential and other properties. Many municipalities are operating residential housing properties which create pollution problems. Even more frequently, municipalities contribute to their own air pollution from the operation of sewage treatment plants, asphalt plants, incinerators, powerplants, vehicles used in public transportation, and similar installations. The city without an effective public refuse collection and disposal system leaves homeowners with little alternative but to employ backyard incineration as a means of disposal. Where the city provides municipal refuse incineration, air pollution frequently is created from the operation of large incinerators. Methods for the correction of air pollution from boilers are well known. Correction of air pollution problems can be handled through education of the public and effective enforcement techniques.

**64-0495**
Blowers accelerate incineration. Engineering News-Record, 173(1):102, July 2, 1964.

A fully enclosed, automatically controlled refuse disposal system that uses forced air to accelerate burning of waste material is described. No fuel is used once the refuse is ignited. Two 9,500 cfm blowers feed air to the incinerator with air velocity gradually and automatically increased to force lighter material into suspension until it is completely burned. The system includes a building for unloading refuse; commercial, industrial, and residential refuse is dumped at the sorting platform, where men remove salvageable material. A pneumatic-tired pusher is used to push non-salvageable material onto a pair of hinged-steel belt conveyors which feed towards the center of the building. Here the refuse is discharged into a 4-ft-wide, 100-ft-long inclined conveyor, which carries it to the burner 40 ft above ground. Refuse is discharged into the burner in a continuous controlled flow and 90 percent is completely burned. The remainder, a combination of ash and non-burnable waste, can be removed by a conveyor located in the base of the burner. Fly ash is trapped by screens located at the top of the burner. An accessory system is available to eliminate smoke.

**64-0496**
Boston seeks federal aid to construct two incinerators. Refuse Removal Journal, 7(8):22, Aug. 1964.

Boston, Massachusetts, is planning to construct additional incinerators to reduce the burden of its over-taxed disposal facilities. Financing of the project will be by a community facilities loan from the federal government. The initial loan will be for $75,000 or one percent of the total cost ($7.5 million) for initial planning. A consulting firm is to be hired upon approval of the loan to determine if incinerators are the solution to the problem. Construction of additional incinerators will permit the discontinuance of the city's open dump. The existing single incinerator produces about 1,000 ton per week of residue and creates the problem of locating proper landfill sites. The additional incinerators would solve many of the problems involved in refuse disposal at present. Another solution which was considered was the use of sea-going incinerator ships.

**64-0497**
Boston turning to marine incinerators. Refuse Removal Journal, 7(7):4, July 1964.

The Metropolitan District Commission of Greater Boston, Massachusetts, expects to receive authority for operating a fleet of seagoing incinerators as a means of solving the area's acute refuse disposal problem and at the same time reduce air pollution. The plan calls for the conversion of several

World War II Liberty Ships to ocean-going incinerators at an estimated cost of $1.5 million per vessel. Preliminary studies indicate the ships could handle up to 1,200 tons of rubbish daily, compared to 600 tons handled by most well-designed land incinerators, which normally cost about $4,000 per ton of capacity. Therefore, a land incinerator with capacity equivalent of one ship would cost over $4 million.

**64-0498**
Bremser, L. W. Incineration. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.108-119.

A brief historical review on the development of the incinerator used for refuse is given. Very little is known about the material to be burned. Some research has been done on the composition of refuse produced in a few midwestern cities but more of such research is needed in other areas of the country. Development of methods of automatic charging will be made more difficult by the physical qualities of refuse. Refuse may mat and tangle and its components may be of all sizes and shapes, making it very difficult to handle mechanically. Perhaps pre-processing to achieve a physically more uniform material would be in order. Modern incinerator designs require that the refuse be moved vertically a long distance in order to have gravity flow through the plant. This is costly when the tons involved are considered. It might be possible to reduce this distance by improved furnace arrangement. If this difference in elevation is necessary, it would seem more practical to elevate the residue which is a relatively small portion of the original weight of refuse. In the furnace itself, maintenance is a major problem. Even in the most efficiently operated plants, the maximum load factor obtainable is less than 90 percent because of routine maintenance outages. Perhaps study would reveal other methods of utilizing the available heat besides steam generation. One possibility might be the use of the waste heat in the conversion of saline water to potable water. In summary, research is needed in all phases of incineration.

**64-0499**
Central incineration. In 1964 Sanitation Industry Yearbook. New York, RRJ Publishing Corp., 1964. p.18.

Central incineration, including its advantages and disadvantages, costs, site selection, truck scales, methods of charging refuse into incinerators, effective combustion temperatures, combustion chamber, and fly ash, is discussed. Screens, air requirements, refractories, stacks, residue handling, transportation of residue, design and construction operation, maintenance, air pollution control, and fly ash emissions are also discussed. Incinerator, furnace, combustion chamber, and subsidence chamber are defined.

**64-0500**
Cerniglia, V. J., and H. J. Campbell. We borrowed from the steel industry. American City, 79(5):89, May 1964.

Incinerator design borrowed from the steel industry, to reduce incinerator maintenance problems is discussed. In Oyster Bay, New York, the 500 ton per day incinerator became overloaded, maintenance and cleaning time were high, and efficiency was down. The modifications made, including thinner, sectionally-supported, air-cooled incinerator walls, the use of slag-resistant super-duty fire brick, and use of stronger-bonding, tongue-and-groove-brick are discussed. Results include 20 percent increased capacity, lower burning temperature, one-fourth the cleaning time, and lower maintenance time.

**64-0501**
Chesarek, R. F. How to select an incinerator bucket. American City, 79(8):80-82, Aug. 1964.

The incinerator bucket or grapple serves as the key link between the incoming material and the furnaces. The three-line cable plan, using one cable for closing the bucket and two cables for holding the bucket, works best. The head of the bucket consists of the head block, head sheaves, guide rollers, related pins, and attached members or the hold lines. If the bucket remains vertical at all times, little bending of the cable over the rollers occurs. The corner bars attach the bucket head to the scoops. The simplest arrangement consists of a single pin connecting all four corner bars and also serving as the head sheave pin. The scoops used in incinerator service are the closed-scoop, or bucket, and the tine, or grapple. Scoops have limited pick-up ability, but serve as a good clean-up tool. The grapple yields an average of 40 percent more pick-up capacity, but has higher cost, greater weight, and is a poor clean-up tool. For new installations, bucket size must be related to crane selection. Incinerator buckets are lightweight, although extremely lightweight ones will not take the abuse. Most incinerator buckets are constructed of mild carbon steel, although some critical items of tine-type grapples should be made of more adequate material. On doubtful items, manufacturers' standards should be accepted.

**64-0502**
Chicago incinerator turns rubbish into saleable products. Refuse Removal Journal, 7(2):18, Feb. 1964.

The residue of a rotary type kiln plant owned by Incinerator, Inc. in Stickney, Illinois, 7 miles southwest of Chicago, can find ready cash markets. The saleable components are reclaimable metal, cinder, and steam.

**64-0503**
Cohan, L. J., and R. C. Sherril. An investigation of combustion air for refuse burning. Presented at National Incinerator Conference, American Society of Mechanical Engineers, New York, May 18-20, 1964.

A test program was set up, using the incinerator of a major municipality, with the following objectives: to determine the location and effectiveness of overfire air; to determine the location and effectiveness of overfire air in conjunction with its ratio to undergrate air in order to determine burning rates, fly-ash carryover, furnace temperatures, secondary combustion. Each comparative test was conducted on the same day as its base test which reflected normal plant operating conditions. Thermocouple lances were used to obtain gas temperatures. A 375 lb per cu yd density for wet refuse was achieved by spraying the refuse in the pit for 24 hr prior to testing. An analysis of the test results shows that the combination of high- and low-pressure overfire air has a direct bearing on increased capacity. Arithmetical averages of furnace outlet temperature indicate more efficient burning of average refuse with proper proportions of underfire and overfire air. Fly-ash carryover should be an area for separate studies. Secondary combustion was minimized or eliminated with proper proportions of high- or low-pressure air.

**64-0504**
Dry dust collectors. Factory, 122(4):88-89, Apr. 1964.

Seventeen dust collecting and filtering units are given individual five line summaries including a picture. Several developments mentioned are reverse air jet flushing, aluminum grate with built-in suction, electrostatic particle removal, fan suction, and glass fiber lint filters. The 17 units discussed appear in the equipment catalog section of the publication.

**64-0505**
Dust removal in refuse incinerator plants. Wasser, Luft und Betrieb, 8(7):426-428, July 1964.

A short review of the different incineration systems is presented. In refuse incinerators which use the heat utilization principle, dust removal is not a problem. However, in smaller plants, a dust removal apparatus is necessary. Experiments with American air filters have shown that the wet dust remover 'ROTO CLONE' and the fly dust remover 'AMER-clone' as well as the 'Dustbox' and the 'AMER-therm' dust removers can be installed. An incinerator used for the incineration of paper was fitted with an AMER-clone filter. Measurements showed that the dust concentration in the crude gas was 210 mg per cu Nm, while after filtration it was only 36.9 mg per cu Nm. It was concluded that crude gas with dust concentrations of not more than 1,000 mg per cu Nm can be controlled by this method. To control larger dust concentrations, experiments were conducted with a silicon glass fiber hose filtering apparatus, which is illustrated. Measurements showed that the dust concentration in the crude gas was 30.8 g per cu m, while only 0.071 g per cu m was found in the filtered gas.

**64-0506**
East Ohio Gas Company. Residential incineration and its benefit to your community. Jan. 1964. 23 p.

A study was made to determine whether or not communities have benefitted by the enactment of ordinances requiring installation of incinerators or sink grinders. A representative sample of communities was selected, and personal interviews were conducted with Service Directors or other persons responsible for garbage and rubbish collection and disposal. Over half of the communities in the Cleveland area having ordinances were contacted. Communities not having ordinances were also contacted to determine whether or not their collection and disposal problems were more acute than those communities with ordinances.

**64-0507**
Fishermen fight Boston plan to incinerate refuse on ships at sea. Refuse Removal Journal, 7(11):16, Nov. 1964.

Boston, which has no adequate means of refuse disposal, will try to pass a bill through its legislature to authorize burning of refuse aboard incineration ships and dumping the residue 20 to 25 miles out at sea. Commercial and industrial fishermen claim that this proposal would be a grave danger to local and world fishing.

**64-0508**
Garbage to gallons with new plant. Water Works and Waste Engineering, 1(2):53, Feb. 1964.

The first plant using heat from a refuse disposal plant to convert sea water to fresh water, will be built by the Hempstead, New York, Department of Sanitation. The $6 million plant will include four AMF Maxim Aqua-fresh heat recovery evaporators. Each of the units could provide up to 112,000 gal of fresh water a day, if operated at full capacity. Present plans call for the operation of only three of the units at one time, with the fourth held on stand-by.

**64-0509**
Gorman, B. Noteworthy features. American City, 79(7):94, July 1964.

The new incinerator of Garden City, New York, features a naturally lighted firing floor, twin receiving bins and an inline layout that reduces the crane span is discussed.

**64-0510**
Hangebrauck, R. P., D. J. von Lehmden, and J. E. Meeker. Emissions of polynuclear hydrocarbons and other pollutants from heat-generation and incineration processes. Journal of the Air Pollution Control Association, 14(7):267-278, July 1964.

A source sampling program on the measurement of pollutant emission levels from a variety of sources includes a section on the incineration and the open-burning of commercial and municipal solid wastes. In addition to the over-all emission data, a primary objective was to establish the relative importance of various combustion processes as contributors of benzo(a)pyrene and other polynuclear hydrocarbons with demonstrated or potential carcinogenic properties. Charts show the design and operational summary of incineration sources.

**64-0511**
Haden J. L. Incinerator model convinces public. Public Works, 95(7):94, July 1964.

A pit-and-crane incinerator with an ultra-modern design is being built at Lowell, Massachusetts. A unique feature is the discharge of residue into containers, which will then be lifted onto specifically fitted trucks, rather than direct dumping from the discharge hopper into receiving vehicles. A display scale model version of the polynuclear hydrocarbon content of particulate matter emitted from incineration and open-burning sources.

the incinerator helped ''sell'' it to the public.

**64-0512**

Herring, F. W. Effects of air pollution on urban planning and development. In Proceedings; National Air Pollution Conference, Washington, Dec. 10-12, 1962. Public Health Service Publication No. 1022. 1963. p.190-199.

Questions are likely to arise, not so much on the basis of need for air resource management, as on the ability to predict and control air quality, on the type of agency best fitted to do the job, and on the administrative tools available or inventable. The chief sources of air pollution are industries, home heating and backyard burning, and burning dumps. Agricultural practices like smudge burning and airplane spraying of insecticide may also be sources of pollution. Vehicles of transportation are the chief mobile source. Open burning of the accumulated waste and refuse of the cities is usually the first to be prohibited in any air pollution control program Planners may make burial of comminuted material with alternate compressed layers of earth the occasion for planning new sites for recreation or light building. Also to be encouraged is joint financing among communities of a plant to convert organic materials from waste into usable forms, or joint financing of an efficient incinerator for combustibles. In Los Angeles County in 1959, it was found that residential land uses contributed less than one percent of the total contaminant emissions after prohibition of backyard burning. The planner's problem in air pollution control is one of locating residences, industries, and agriculture, parks, recreation areas, and freeways so as to minimize conflicts of interest while permitting normal area growth. Regional planning and some limited type of metropolitan government is necessary.

**64-0513**

Hiller, H., and L. Mackowski. A method of determining the heating value of heterogeneous waste. Gas, Wasser, Waerme, 18(2):26-29, 1964.

For determining the heating value of heterogeneous waste a test incinerator was constructed, equipped with an adjustable gas burner whose heat development could be measured. Thermometers and a meter to measure the amount of flue gas were installed. The combustion chamber was designed to hold about 20 kg of waste. An illustration and detailed description of the test setup are given. The apparatus was calibrated with fuels of known heating value. The well-mixed and crushed waste was weighed, filled loosely in the combustion chamber, and ignited. When the flue gas temperature and the carbon dioxide contents in the flue gas sank, the incineration process was considered completed. The remaining ash was weighed. For the theoretical evaluation of the experiment the following data were obtained: amount of heating gas and flue gas, carbon dioxide content of the flue gas, amount of cooling water and condensation water, temperature of flue gas before and after cooling, and water temperature before and after entrance into the refrigerator. The surplus heat calculated from these data and referred to the unit of weight, yields the incineration heat (upper heating value) of the waste. A numerical example is given. (Text-German)

**64-0514**

Honeycomb armour protects tipping floors. American City, 79(6):26, June 1964.

A veneer honeycomb of steel mesh and concrete filler protects the Merrick, Long Island, New York 40 by 70 ft incinerator tipping floor. This saves the under floor from the abrasion of track-type vehicles.

**64-0515**

Incineration of household refuse. Surveyor and Municipal Engineer, 123(3755):51-52, May 23, 1964.

The incineration characteristics of household refuse are reported as the result of tests performed to determine the effect of high ash and pulverizing. The normal operation of the incinerators involved includes facilities for removing cans, pre-picking, and pulverizing. The samples included: (1) pulverized refuse with cans removed; (2) ash removed as well as tins, but not pulverized; and (3) a sample representing British summer refuse, but with more glass than normal and pulverized. Sample 1 was typical of the high ash British winter refuse and sample 2 was typical of the U.S. refuse. It was found that the high ash content and pulverization speeded the combustion. Samples 1 and 2 burned uniformly and a small water-spray cleaned the flue gases. With sample 2, the mass had to be poked and the burner had to be switched on to complete combustion. The smoke emission was dense at times and the after-burners had to be ignited for short periods. No trace of glass could be found in the pulverized sample ash. The ash in sample 1 mixes with the vegetable matter and absorbs the moisture which increases the burning rate. The glass in sample 3 does not absorb the moisture and thus the burning rate is slower than in sample 1.

**64-0516**
Incinerator. Engineering, 197(5105):284, Feb. 21, 1964.

The Advel Venturi incinerator for disposal of general refuse, confidential documents and garden rubbish are described. The shell is mild steel sheet; grate and secondary air feed are cast iron. With the exception of the grate components, all parts are hot dip galvanized. The secondary air flow unit is explained as a hollow, conical part in the center of the grate to increase air flow and provide balanced combustion at the center of the incinerator. Models available have 3.4 and 5 cu ft capacities.

**64-0517**
Incinerator. Engineering, 198(5149):823, Dec. 25, 1964.

The Sealed Flame disposal unit made by Universal Machinery and Services Limited is described. Reported to be entirely smokeless with every type of refuse (wet or dry), four models with capacities ranging from 26 cu ft to 170 cu ft are discussed. Approximate burning rates are given for each. The arrangement of the air tubes make it impossible for the material being burned to lie flat with the result that everything is surrounded by air and burnt right through.

**64-0518**
Incinerator develops power and produces own fresh water. Public Works, 95(5):152, May 1964.

The new 750 ton per day refuse disposal plant being built for the Town of Oceanside, Long Island, New York, has a waste heat recovery complex providing both power generation and salt water conversion. The plant design and equipment is described. With the large quantity of steam available, it was determined to be economically feasible to use desalting units in place of the condensers that would otherwise have been used in the steam cycle. The exhaust steam from the various turbines and the excess steam is used in inexpensive single-stage, single-effect, submerged-tube evaporators to produce about 115,000 gal of fresh water per day for in-plant uses. The total construction cost of this unique plant will be about $6,000,000.

**64-0519**
Incinerator for harbor debris and demolition materials. Public Works, 95(9):140, Sept. 1964.

A special incinerator was developed to facilitate the incineration of large wood piles, timber beams, floating debris, and demolition products found in harbor areas such as New York. Without further processing, materials ranging from a few inches to 30 ft in length can be destroyed by this incinerator, which incorporates a new method of charging and a stoker system compatible with the type of material to be destroyed. A traveling crane with specially designed grappling hooks, similar to cranes used in logging operations, handles the large pieces. The charging gates are to be installed adjacent to each other, so that when operated together they will provide a 30 by 8 ft opening for charging. The pneumatically or electrically operated gates, in tandem, can be controlled by the crane operator. The incinerator will use inclined alternate moving stoker bars, which will provide for initial drying and ignition at the point of entry, and will gradually move the debris forward to the high temperature end of the incinerator for complete destruction.

**64-0520**
Incinerator for unsorted waste. Food Processing, 25(12):100, Dec. 1964.

The new KVS incinerator, which handles unsorted, wet and dry refuse, and which meets all local air pollution ordinances is described. The heart of the system is a perforated, stainless steel rotating cone which continuously tumbles waste material during combustion. Small-sized ash and non-combustibles fall through the perforations onto a grate.

**64-0521**
Incinerator saves 25 percent in disposal expense. Modern Hospital, 102(5):138-140, May 1964.

By installing its own gas-fired incinerator, the 300-bed Grandview Hospital of Dayton, Ohio, has eliminated flies, odors, unsightly accumulation of waste, and the noise of trash collection operations. The rising cost of the previously employed collection service was another disadvantage of the older system. The new incinerator, which had a daily capacity of 950 lb, will keep pace with the hospital's growth and with the increased use of disposable and packaged supplies. The automatically timed incinerator can handle both plastic and rubber items, plus organic wastes from surgery. It is attended by two part-time employees. Cost of the incinerator itself is $9,800.

**64-0522**
Incinerator uses cone-shaped grate. Refuse Removal Journal, 7(11):30, Nov 1964.

A radically new incinerator for municipal, commercial, industrial, and institutional use disposes of waste materials with complete burning of all objectionable odors, total fly ash removal and minimum ash residue. A chief feature of the incinerator is a cone-shaped steel grate which continuously tumbles the refuse. This tumbling action helps to break the refuse into smaller pieces, providing maximum surface air exposure.

**64-0523**
Incinerators in Northeastern Illinois. Public Works, 95(10):174, Oct. 1964.

There are ten incinerators in use in northeastern Illinois with a total rated capacity of 4,762 ton per 24 hr, and an 'effective capacity' of 5,354,000 cu yd per year based on 250 full working days per year and 4.5 cu yd of refuse per ton. These data are based on the 1960 Eastern Illinois Metropolitan Area survey of the area by the North-Planning Commission.

**64-0524**
Jacke, W. Costs and economy of waste incinerator plants. Staedtehygiene, 15(7):166-167, July 1964.

The costs of a waste incineration plant are mainly determined by the size of the waste storage bunker, by the flue gas filters necessary to comply with the air pollution regulations, and by the means required to cool down the flue gases to 300 C, the operating temperature of the electro filter. Carefully conducted cost investigations showed that a waste incinerator, operated in connection with a low-pressure steam generator, is most economical. Total costs in this case run at about $4.50 per ton of waste. Part of the costs can be recovered by selling the steam, ash, and scrap metal. If there is no possibility of using the heat, the flue gases must be cooled down by either adding cold air or by injecting water. The first method can be discarded because of high costs due to the increase of volume of the flue gas. With the second method the total cost per ton of waste run at $5.50 because of the water costs involved. A less expensive third method has been developed. The flue gas is cooled by generating low pressure (14 atm.) steam which is subsequently condensed in an air-cooled condenser and the water is used again. The investments are about the same as for the water injection method; the total costs per ton of waste, however, are much lower. (Text-German)

**64-0525**
Long Island incinerator to convert salt water. Refuse Removal Journal, 7(3):12, 16, 25, Mar. 1964.

An ultra-modern, 700-ton capacity incinerator being built at Hempstead, located on the South Shore of Long Island, New York, will also contain a unique saline conversion unit capable of changing over 300,000 gal of salt water to fresh water daily. The incinerator will utilize waste heat from its own furnaces as the fuel source. The water will generate electric power for the plant through a steam turbine. The plant will need 288,000 gal of water every 24 hr. The conversion unit is being installed because no fresh water is readily available and salt water would cause marine growth in the pipes. This conversion eliminates the normal requirements of a deep water well and an extensive steam condenser complex, and it prevents huge reserves of water from being drawn from the Township's already overtaxed underground resources.

**64-0526**

Meissner, H. G. Air pollution from incinerators. Civil Engineering, 34(9):40, Sept. 1964.

Design and operation of the furnace as the keys to the control of air pollution from incineration are examined. The control of combustion air is vital to the performance of an incinerator.

**64-0527**

Meissner, H. G., and H. C. Johnson. Discussions of 'The problems of applying incinerator criteria.' Journal of the Air Pollution Control Association, 14(9):366-377, Sept. 1964.

The contentions that flexible criteria are more desirable than rigid criteria for incinerators, that rigid criteria hold back design improvements, and that efficiency of operation and construction costs should be considered in rating incinerators, are attacked as invalid. The incinerator criteria are compared to the building codes and specifications which define what is acceptable so that the designer will know in advance what to expect and how to plan. With flexible criteria, the examiner's personal opinion may decide approval or disapproval. Provision is made in both the New York City Criteria, and in the Los Angeles Criteria for experimental or temporary permits with the final approval given when the incinerators are found to operate satisfactorily. The rating of incinerator design on the basis of efficiency of operation and construction costs is totally unacceptable to a control agency, since this would favor a poor design. The tests described in the original paper on three incinerator designs were of such short duration and under such unfavorable operating conditions that the results would be considered unsatisfactory for all three designs. Test results will not be representative of actual emissions unless the materials burned represent the usual type of refuse to be burned and the incinerators are operated in the manner expected of the majority of the operators.

**64-0528**

Moore, H. C. Express concern for air pollution at incinerator conference. Heating, Piping and Air Conditioning, 36(8):102-103, Aug. 1964.

Papers presented at the First National Conference on Incineration held in New York, May 18-20, 1964, are summarized. Technical sessions, devoted to different phases of the incinerator process as well as to the material and equipment involved, covered general design, refractories, furnace design, materials handling, heat transfer and recovery, air pollution control, incinerator plant operation, instrumentation and controls, and apartment building incinerators. Highlights of the thirty-two papers presented include: (1) the responsibility of a consulting engineer in laying out a plant to meet all current requirements of design and performance; (2) a review of various control methods for air pollution; (3) the removal of fly ash by electrostatic precipitation; (4) the effect of furnace design and operation on air pollution; (5) health aspects of air pollution from incinerators; (6) the development of continuously fed furnaces with boiler located on top; and (7) operating problems in a large plant.

**64-0529**

New York incinerator burns one million dollars a day. Refuse Removal Journal, 7(5):30, May 1964.

An incinerator of the New York Federal Reserve Bank burns old and frayed silver certificates. The New York bank is one of twelve banks throughout the country that destroys millions of dollars daily. Federal Reserve notes are separated from the silver certificates and are shipped to the Treasury in Washington for destruction. Destruction of the silver certificates is also discussed.

**64-0530**

Nine towns ask for refuse area plan. Refuse Removal Journal, 7(6):26, June 1964.

Nine towns in Northern Westchester County, New York, have petitioned the Board of Supervisors to set up a refuse district that would build and operate a multimillion dollar incinerator at Croton Point Park on the Hudson River, adjacent to the Harmon Yards of the New York Central Railroad. The towns claimed that urbanization had eliminated suitable incinerator sites in the nine-town area. The board ordered a study of costs of the proposed district and incinerator, which the nine towns would share on a cooperative basis.

**64-0531**
Officials complain pressurized cans endanger employes. Refuse Removal Journal, 7(3):27, Mar. 1964.

Department of Sanitation heads in some communities are urging residents to store pressurized cans in separate receptacles, where collection crews can hold them aside for disposal in landfill operations, since these cans explode when they hit the flames in incinerators, thereby injuring incinerator stokers.

**64-0532**
Omaha plans paunch manure incinerator. Engineering News-Record, 173(20):59-62, Nov. 12, 1964.

Paunch manure, the undigested material consisting principally of straw, hay, or corn, and gastric juices, found in slaughtered beef cattle, poses a difficult disposal problem in Omaha. An entirely new method of disposal developed by city engineers and due for initiation in November 1966, is described. The paunch manure will be transported through city sewers to a treatment plant where it will be separated, dewatered, and burned. Since the packing plants where the manure originates are on high ground, the hydraulic gradient is steep enough to keep it from settling and lodging. A series of separation tanks allows the paunch manure to settle while channelling off the effluent for treatment in the existing sewage plant. To solve a tough dewatering problem, a brewing industry press was found to work. Material fed in at the top is compressed by a wedging action as the rotation of two opposed perforated disks carries it downward. Moisture escapes through the perforations and goes to the regular treatment plant, while the dewatered material goes by belt conveyor to a surge pile en route to the incinerator, a rotary kiln much like those used in the manufacture of cement. The installation is expected to cost $1.9 million, with maintenance and operation cost expected to be $147,900 annually.

**64-0533**
A ram-fed incinerator. American City, 79(12):69, Dec. 1964.

Three of the distinctive features of the new, attractive incinerator in Clearwater, Florida, are: a ram feeder that places the refuse in the furnace; a quench tank and drag conveyor which produce a cooled, dust-free incinerator residue; and the use of the effluent from the adjacent sewage-treatment plant as the process water for the entire operation, and the return of all waste water to the sewage-treatment plant for reprocessing before its discharge into the bay.

**64-0534**
Rasch, R. Furnaces for waste incineration. Brennstoff-Waerme-Kraft, 16(8):376-382, Aug. 1964.

The various kinds of furnaces suitable for waste incineration are surveyed. The designs are classified according to their capacity, kind of grating, furnace material, and utilization of the combustion heat. Dust removal from the flue gas and the treatment of the slags (sintering, granulation) are also discussed. It is pointed out that, in order to ensure the most economical operation of a waste incinerator plant, it is necessary to carry out extensive preliminary studies to estimate the amount of waste expected, the costs of waste collection, and transportation of the ashes. Revenues from the sale of heat, electricity, and processed slags should not be overestimated. (Text - German)

**64-0535**
A regional approach to refuse disposal. American City, 79(6):94, June 1964.

New Haven, Connecticut, and two neighboring towns plan to build an incinerator to replace open dumps. The 750 ton per day plant, and financing and billing programs are described.

**64-0536**
Rihm, A.
Air pollution control in New York State.
Civil Engineering, 34(2):56, Feb. 1964.

The Air Pollution Control Board set up in 1957 in New York State is described. Built on an effective legal foundation, the Board has grown in influence and effectiveness. The personnel, and services such as air monitoring, are explained. The Board also initiates control rules which help abolish problems from rubbish burning, automobile exhaust, and inefficient incineration.

**64-0537**
Riley gas or oil fired incinerator.
Surveyor and Municipal Engineer, 124(3764):44, July 25, 1964.

The Riley 'Gaserator' , a commercially available highly rated incinerator developed for the destruction of hospital and similar waste, is described, and the manufacturer's claims are listed. The device may be operated with gas or oil as auxiliary fuel to insure complete combustion of malodorous combustible gases. An installation in a 400 patient and staff general hospital consumes 580 lb of waste per hr with a gas consumption of 1,500 cu ft or 7.5 therms. General refuse, kitchen, and pathological waste, as well as dressings and material from the operating theatre, are included in the charge. There is no smoke emission and the residue of bottles and cans is completely sterile. The equipment occupies a ground area of 20 by 30 ft. The equipment is made in 10 sizes to burn from 300 to 6000 lb per 8 hr day. The equipment can handle waste products from factories which normally cause disposal problems. The basis of the operation is the injection of secondary air after the products of combustion has passed from the initial combustion chamber. This permits the destruction of all smoke producing elements.

**64-0538**
Rogus, C. A. Incinerator design. Part I.
In Solid waste disposal and municipal equipment 'rental' . New York, Buttenheim Publishing Corporation, June 1963. p.13-18.

Disposal of refuse by incineration is inherently prompt, thorough, and complete. The capability of incinerators to dispose of all but the bulkiest solid wastes is matched only by the sanitary-fill method. The major disadvantages of incineration are: higher initial costs of construction, generally higher costs of operation and maintenance, and the need for secondary disposal of the residue. The design should relate over-all incinerator capacity to the amortized life of the plant and the estimated quantities and types of refuse anticipated within this life. The design also must relate the fact that incinerators operate best at 80 to 85 percent of rated capacity. Incinerator furnaces may be circular, square, or rectangular chambers equipped with either stationary or moving grates of the rocker, reciprocating, or traveling types. The principal components of a typical incinerator consist of: receiving and storage facilities, refuse-handling facilities, furnaces, residue-removal system, fly-ash removal system, and exhaust gas system. Extensive field tests indicate that for practically all operating conditions and types of mixed refuse, the use of 50 percent underfire air and 50 percent overfire air provides the maximum burning rate consistent with a good residue and the minimum emission of particulate matter.

**64-0539**
Rogus, C. A. Incinerator design. Part II.
In Solid waste disposal and municipal equipment 'rental' New York, Buttenheim Publishing Corporation, June 1963. p.19-24.

The basic elements that affect initial costs of incinerators are: type of foundations required; degree of refinements required locally against dust, odor, and stack emission; interior clearances for headroom, maneuvering, and operating space; capacity of storage pits; enclosure or non-enclosure of tipping floor area; and enclosure or non-enclosure of furnace and operating areas. The best performance requires skilled operation and supervision based on meaningful operating data gathered with the aid of proper instrumentation. The three, major variables controlling efficiency of burning are refuse, air, and water. The skill used in their proportioning and points of application should be guided by pertinent data obtained from instrumentation. To date, too few instruments are installed, and even fewer are used and kept in operable condition. Information that should be obtained on a continuing basis includes: quantities of refuse charged and residue taken out: stoker speeds and cumulative footage traveled; and amounts and locations of under-fire and over-fire air. Maintenance should be of both the preventive and routine type. The cost of proper maintenance may be expected to run between 5 and 10 percent of the total cost of operation.

**64-0540**

Rogus, C. A. Municipal incineration of refuse: foreword and introduction. Journal of the Sanitary Engineering Division, American Society of Civil Engineers, 90(SA 3):13-26, June 1964.

Dumping refuse is unsanitary and hazardous to health. Reduction disposal practices have decreased with the development of synthetic detergents and fertilizers and with the high costs of odor-reduction equipment. Piggeries necessitate separate, costly collection. Grinding of garbage is quite sanitary, but can be costlier than incineration. Domestic incinerators are beneficial in reducing the municipality's load, but may be unsafe. Operating elements, requirements, and costs of both composting and sanitary landfill are included. Major components and functions of municipal incinerators include tipping floors, storage pit, furnaces and residue system, combustion and substance chambers, and chimneys. Incineration is prompt, thorough, and complete. Its major disadvantages are higher costs, need for skilled operators, and the need for secondary disposal of residue. Incinerator operation in the United States began in the late 1800's. In 1929 three 500-ton incinerators were opened in New York City, triggering similar progress across the continent. Until about 1930, operation costs were reduced through salvaging marketable products, but these salvagables were replaced by plastics and synthetics. In determining a plant's design capacity, consideration must be given to the plant's objective, its amortized life, type of refuse processed and variations in refuse output, number of plants, operating shifts, and plant operating factor. Incineration costs are enumerated, and tables are included. Research needs are discussed, including auxiliary heating, stack emissions, and other nuisance and abatement measures. Alternate methods of disposal, such as dumping on land, dumping into lakes and oceans, grinding, domestic incineration, etc., are discussed.

**64-0541**

Sager, J. C. Minneapolis-Saint Paul sanitary district incinerates scum. Water and Sewage Works, 111(9):393-396, Sept. 1964.

Various methods of scum collection and disposal used at the Minneapolis-Saint Paul Sewage Treatment Plant since 1938 and found to be relatively unsatisfactory are described. Inquiries into incinerators and Bump pumps starting in 1957 led to the development of a scum incineration system which is described through several stages of modification. Diagrams and photographs of the final system are included. The process of scum collection consists of hand skimming with special rakes in scum troughs. Successive equipment in the process includes a disintegrator, 3-in. Bump pump, decanted liquid receiver, feeder tank, and 2-in Bump pump. The incinerator has no moving feeding equipment or grates, and has primary and secondary combustion chambers. The draft is controlled by an automatic motorized guillotine damper in the breeching. The 4 oil burners are automatically controlled, and burn No. 2 oil with an indicating pyrometer for each and a cut-off at 1,600 F. During the first three months of 1964, 630.5 ton of decanted scum were incinerated using an average of 5.8 gal of No. 2 oil per ton of scum.

**64-0542**

Sea-going trash burners. Engineering News-Record, 172(7):51, Feb. 13, 1964.

A $2 million scheme to convert old World War II Liberty ships into floating refuse incinerators for the Boston metropolitan area is reported. Trucks would load the incinerator ships, which would sail 20 miles out to sea, fire up their incinerators, and dump the ashes at sea.

**64-0543**

Shequine, E. R. Steam generation from incineration. Public Works, 95(8):92, Aug. 1964.

The potentials for energy recovery from refuse incineration are examined. Different types of steam-generating boilers are discussed. The plant at Hempstead, New York, is a relatively good model of an incinerator fully utilizing waste heat.

**64-0544**
Skitt, J. The furnace. In Disposal works: plant and maintenance. London, Temple Press Books Ltd., 1964. p.37-58.

The historical development of the furnace for refuse incineration is reviewed. Probably the most important development was that of forced draught, in which air was forced through from the underside of the grate, obviating the need for high chimney stacks and slowing the rate of the gases, movement through the flues for more efficient combustion. The incineration unit today is built of steel casings with division plates built up to the grate level. At grate level, which is a suitable height for stoking and clinkering, the only separation of cells is the division casting. The firebars are located on the front deadplate and rest on the back casting. The roof of the furnace is in the form of a firebrick arch. At one end of the continuous grate is the combustion chamber into which the intermingling gases pass. Modifications of the modern incinerator are discussed. The furnace, by securing complete combustion, renders refuse innocuous. To achieve complete combustion there must be an adequate quantity of air supplied to the furnace, the temperature of the furnace must be correct and the intermingling of gases must be sufficient. The efficient cleaning of flue gases is accomplished through an apparatus referred to as the Water Trough. Electrostatic precipitation is the most efficient, yet the most expensive method for flue dust extraction. Dust passing through an air gap between negative and positive electrodes becomes ionized and moves toward the positive electrode. Incinerators which use different principles of operation are the revolving grate type and the stepped grate type. The operation of the Morse Boulger incinerator, which is currently in use in the United States, is discussed.

**64-0545**
Skitt, J. Trade refuse incinerators. In Disposal works: plant and maintenance. London, Temple Press Books Ltd., 1964. p.60-61.

Trade refuse incinerators are used for the bulky refuse which cannot be handled by the separation plant. This refuse consists of furniture, carcasses, offal, and bulky trade refuse which were previously burned in the combustion chamber. Trade refuse incinerators usually consist of one cell only, although more than one may be required if general incineration is not practiced. The location is of particular importance because of the need for the direct discharge of waste materials into the furnace without handling. An existing chimney stack should be used. High-pressure air is used when burning 'difficult' material. An independent unit warrants serious consideration in large plants and can provide heat for the hot-water and heating system. The design of the furnace is similar to that used for domestic refuse although certain design problems must be taken into account. In order to allow the feeding of bulky material with as little breaking up as possible, it is necessary to have a large opening. Although feeding from the top is itself most desirable it is likely to weaken the main arch and this can be resolved by arranging the storage platform so that charging can be made through an aperture in the top of one of the side walls of the furnace. The grate must be of very substantial construction and the possibility of dispensing with the grate and having the firebed on the firebrick floor with primary air at, or very near to the ground level should be considered. Because considerably higher temperatures can be expected than in a house-refuse incinerator, maintenance tends to increase. Considerable heat and adequate combustion space must be provided, or the provision of an 'after burner' may be necessary.

**64-0546**
Small plant sludge incinerator. Engineering News-Record, 172(20):50, May 14, 1964.

A small sludge incinerator, called the cyclo-sludge destructor, was designed for economical operation in a small plant. It can follow-up any type of dewatering apparatus, such as a centrifuge, a vacuum filter, or a screen. Operating costs of this automatic incinerator depend on the extent of combustibility and the moisture content of the sludge. After dewatered sludge is delivered to the incinerator's hopper, a screw conveyor pushes it into the system where it is finely divided, mixed with air, and blown into the combustion tube. A ring burner raises the temperature in the tube to about 1,800 F, which ignites the air-sludge mixture immediately. Combustion of the mixture itself helps maintain the necessary burning temperature, and the burners automatically switch to a low fire after combustion is well established. Gases are scrubbed and cooled in a water spray before dispersion to the atmosphere. It is claimed that combustion is sufficiently complete that the discharged gases contain no smoke, odor or other pollutants. The burners can operate on natural gas, methane, butane, or No. 2 fuel oil. The cost, including installation, is about $15,000.

**64-0547**
Stenburg, R. L. Modern incineration of community wastes. Civil Engineering, 34(9):40-41, Sept. 1964.

The increasing use of incineration for the disposal of solid wastes in both municipal and smaller units is discussed along with the problems that have developed in some cases. The expenditures in some cases may be in the millions. Communities such as Winchester, Kentucky, population 10,000, has a 100 ton per day incinerator. Excessive discharges of smoke and fly ash force the abandonment of many incinerators not designed for optimum combustion. The backyard incinerator with a single-chamber design has been banned in Los Angeles. Municipal incinerators have been taken out of service in Los Angeles because they could not comply with the air-pollution control ordinances. Although excessive emissions from incinerator stacks often reflect inadequacies in design of gas combustion equipment and gas conveying flues, poor operating procedures and improper firing practices are often responsible for excessive emissions. Continuous charging into multiple chamber units has improved combustion. Water spray scrubbers which have been effective on smaller units are now being tried experimentally on municipal units. Good design and good operating procedures are necessary for incinerator operation.

**64-0548**
Stenburg, R. L. Modern methods of incineration. Air Engineering, 6(3):20-21, 34, Mar. 1964.

Improvements in incinerator designs and operating practices are requisite for more effective air pollution control. The principal difficulties in burning solid waste materials are nonuniformity of fuels and engineering, ignorance of certain basic combustion concepts in incinerator design, and firing practices. Single chamber units, for example, are still employed without sufficient arrangement to promote good mixing between volatilized gases and oxygen. This hampers the escape of unburned compounds to the atmosphere. Similarly, complete combustion requires minimum temperatures ranging from 1200 to 1600 F; many plants never exceed 1000 F, again leading to pollution. Turbulence requirements also are too often overlooked, especially in the lower micron ranges. Water spray scrubbers can reduce particulate emissions below 0.85 lb per 1000 lb flue gas by diminishing the amount of underfire air flow; however, they also are not employed on a wide-scale basis. As included figures show, work must be done in incinerator design and operation to bring about needed improvements. Elimination of cold furnace burning, single chamber units, cyclic type burning, and natural draft systems are advocated strongly. A means of dealing with excessively wet refuse, achieving better levels of combustion, building units operable by untrained personnel, and establishing continuous feed systems must be discovered and implemented.

**64-0549**
Stephenson, J. W. Get the best incinerator for your engineering dollar. In American Public Works Association Yearbook. Chicago, American Public Works Association, 1964. p.198-203.

The need for good qualified engineers to design refuse incinerators is stressed. There should be constant consultation between engineer and manufacturer during the design period. The engineer must be able to determine the type of equipment such as the stoker, based on his knowledge and experience. It is important not to cut corners on design and construction of incinerators. The contractor's responsibility and the municipality's responsibility are explained. Due to air pollution control requirements, the cost per ton daily has increased from $3,000 several years ago to $4,000 to $6,000 today.

**64-0550**
Stephenson, J. W. Planning for incineration. Civil Engineering, 34(9):38-39, Sept. 1964.

The need for control by state health authorities (similar to that exercised over water and sewage treatment plants) over municipal incinerators and other refuse disposal facilities is discussed. Minimum design criteria should be established as well as minimum standards of operation. If possible every engineering contract for the design and supervision of the construction of an incinerator should include provisions for the designing engineer to supervise plant operations for 6 months to a year. A performance-type specification may be desirable in the facilities for fly-ash removal. While plans and specifications must be complete, leaving as little as possible to the discretion of the contractor, he should not be relieved of the responsibility of furnishing materials, workmanship, and equipment in accordance with specifications. No engineer should attempt to include major equipment in his design without the advice of the manufacturer on its application. The final decisions and the responsibility for the design of an incinerator must be with the engineer.

**64-0551**
Three-stage incinerator. Food Processing, 25(8):126, Aug. 1964.

The Model FG4-4 gas-fired incinerator installed at Borden's Farm Products in Newark, New Jersey, has three burning chambers through which refuse passes. It saves $2,000 per year in labor handling costs, and meets Newark's air pollution requirements.

**64-0552**
Undercover agent. Public Cleaning, 54(12):1360, Dec. 1964.

The totally sealed flame on-site unit produced by Universal Machine and Services Limited of Great Britain is designed to give completely smokeless and odorless disposal of any type of combustible material with simple loading and operation.

**64-0553**
U.S. Public Health Service. Division of Air Pollution. Proceedings; National Air Pollution Conference, Washington, Dec. 10-12, 1962. Public Health Service Publication No. 1022, 1963. 436 p.

The conference was called to proved a forum in which the many segments of society involved with, and affected by, air pollution could present their ideas and recommendations for more effective control of a growing environmental problem. The views of public administrators, scientists, physicians, engineers, industrialists, urban planners, and many others are presented. The sessions and panel discussions covered: statesmanship in air pollution control; air pollutants from the automobile, truck, and the bus; air pollution from industrial plants, powerplants, and the municipality; health considerations; agricultural, natural resource, and economic considerations; applying measuring and monitoring knowledge to air pollution control; applying control equipment and meteorological control knowledge; applying legislative and regulatory knowledge; and applying public information and sociological knowledge to problems of air pollution. Appendices include listings of the staffs of committees related to the conference; statements by the National Association of Manufacturers, and the Public Health Service; listings of exhibits and film programs; and an index of participants.

**64-0554**
Velzy, C. R., and C. O. Velzy. Unique incinerator develops power and provides salt water conversion. Public Works, 95(4):90, Apr. 1964.

The new incinerator at Hempstead, New York, which consumes 750 tons per day, provides special features for burning bulky rubbish, converts salt water to fresh water, and fully utilizes waste heat.

**64-0555**
The Victor 2, gas-fired incinerator. Smokeless Air, 34(129):256, Spring 1964.

The Victor 21 to 2 cu ft incinerator, which will effectively destroy large loads of placenta, hospital dressings, ward waste, etc., is described. It is listed by the Gas Council as a recommended appliance complying with the Clean Air Act. To operate the incinerator, a foot pedal is depressed which opens the leading door to make the waste material, a dial is set to the required burning period, and the incinerator then operates automatically with a cutoff when the burning period has been completed. Two safeguards for reloading during burning are described.

**64-0556**
Voelker, E. M. The problems of applying incinerator criteria. Journal of the Air Pollution Control Association, 14(9):363-365, Sept. 1964.

The many different standards and criteria adopted by community, county, and State Air Pollution Control Authorities, which appear in some cases to be based on individual whims and not on a consensus of experienced designers, have confused the designers of incinerators. The need for test procedures and incinerator criteria acceptable to all Air Pollution Control Authorities is of vital importance to the incinerator industry. Incinerator criteria are in two categories: the rigid criteria in the form of charts and diagrams covering only Type 1 and 2 Wastes; and the flexible criteria covering all types of wastes by setting minima and maxima governing the incinerator design. In the East, there are rigid criteria, based on the assumption that combustion chamber, while in the Far West there are criteria based on the assumption that multiple chambers are required for complete combustion. In Allegheny County, Pennsylvania the products of combustion exceed 5 ft per second, while in Columbus, Ohio, there must be an area where the combustion products exceeds 55 ft per second. There are schematic drawings of five incinerators, each with a rated capacity of 1000 lb per hr of Type 1 Waste. One manufacturer has incinerators constructed for test purposes which conform to the three leading codes. The New York City, the Los Angeles, and the Incinerator Institute of America. The latter code incinerator was 20 percent more efficient than the Los Angeles, and 100 percent more efficient than the New York code incinerator. The variety of code criteria emphasizes the need for a universal code to end the confusion.

**64-0557**
Walker, A. B. Electrostatic precipitators. American City. 79(9):148, 150. 152, Sept. 1964.

Tests on electrostatic precipitators indicate that they can practically eliminate the noxious fly ash from large incinerator stacks. With the possible exception of bag filters, not yet used for this purpose on a commercial scale, electrostatic precipitators appear to be the only practical type of collector able to operate at required high recovery levels. Application of industrial-type precipitators appears most logical for larger incinerators where operating conditions are relatively stable. They are not now recommended for application to small flue-fed or fixed-grate incinerators, such as those used in apartment houses or commercial buildings. But they are practical right now for municipal and industrial plants for 50 ton per day capacity and up. These conclusions and many others are presented, on the basis of tests conducted at the East 73rd Street incinerator of New York City's Department of Sanitation.

**64-0558**
Waste elimination. Plastics World, 22(12):52, Dec. 1964.

Installation of a gas-fired incinerator at Willson Products Division plant in Reading, Pennsylvania, eliminated a 100-mile weekly refuse trip and freed a man for other plant maintenance duties. Most of the company's production waste is in the form of plastics cuttings with felt, paper, wood, and rags making up the balance. When the county imposed dumping restrictions, the firm decided to install an incinerator. Drums are brought to the incinerator area from throughout the plant; they are fed to the unit one at a time. By 3:00 pm, the daily accumulation of trash is completely burned. The resulting ashes, plus non-combustible waste, amount to only a partial load for a private cartage truck which stops twice a week at the plant. Despite the fact that plastics and felt are difficult to incinerate, combustion within the incinerator is complete. Subjected to three stages of combustion, the approximate weekly load of 100 drums of trash is reduced to less than two drums.

**64-0559**
Wegman, L. S. Planning for incineration. Civil Engineering, 34(9):35, Sept. 1964.

Requirements that should be considered in planning an incinerator are discussed. These include: capacity, location, topography, the prevention of air and water pollution, subsoil exploration, residue disposal, the storage bin size, costs, and the changing habits of people.

**64-0560**
Weisburd, M. I. Air pollution control field operations manual; a guide for inspection

and enforcement. Washington, U.S. Public Health Service, 1962. 285 p.

Much of the information included here is based on the 14 year experience accrued by the Los Angeles County Air Pollution Control District, and was originally used to prepare a training manual for the field personnel of the Los Angeles District. In implementing a practical field control operations program, the considerations that must be taken into account are: the air pollution saturation potential of the air space, the pollution zone, and the pollution potentials. The organization of the Air Pollution Control Agency, its field operations, and the role of the air pollution inspector are described in detail. The laws of air pollution control are reviewed as well as the promulgation of control and detection are illustrated. Tracking sources of public nuisances such as odors, stains and deposits, and methods of handling citizen complaints are considered. Sample forms used by the Los Angeles Agency are included where pertinent. A detailed subject index completes the manual.

**64-0561**
Wrecking firm plans new disposal plant. Refuse Removal Journal, 7(3):23, Mar. 1964.

Ashland Reduction Co., a subsidiary of National Wrecking Co., has asked the zoning board to grant a special use permit for the construction of a $2.5 million debris incinerator near the Union Stock yards in Chicago. The proposed incinerator is designed to burn about 12,000 tons of debris a day. Privately owned public incinerators were legalized recently by the city council to permit wrecking companies to burn debris from razed buildings, since suburban dumps refuse to accept city debris. The three city incinerators are designed for burning refuse, and are not open to wrecking companies.

## INCINERATION–Europe

**64-0562**
Andritzky, M. Extension of the waste incinerator power plant in Munich. Brennstoff-Waerme-Kraft, 16(8):403, Aug. 1964.

An extension of the waste incinerator plant in Munich, West Germany, is planned. The boiler will produce 365 tons of steam per hr at 540 C. Twenty percent of the steam is produced from waste (40 ton per hr), the rest from coal. The generators have a capacity of 110 MW. Part of the energy will be used to supply heat to a nearby housing development. A diagram of the steam generator is shown. (Text-German)

**64-0563**
Ball, A. Refuse incineration: a modern approach to an old problem. Public Cleansing, 54(6):963, June 1964.

The incinerating process developed by CJB's Associates at Esslingen, Germany is described. The process is the latest in incinerator design. A grab lifts the refuse from a large capacity, totally enclosed receiving hopper, and feeds it into the furnace. Odors are destroyed by the furnace temperatures. The advanced design of the furnace, which allows for efficient turnover of refuse, keeps the grate small and eliminates after-burning. The grab feed is preferred over a conveyor belt because it gives the operator greater control. The incinerator can be operated by only three men.

**64-0564**
Barrel-grate incinerator rounds out third test year. Power, 108(5):74, May 1964.

The Flingern Plant of the municipal generating station in Dusseldorf, Germany, has completed 3 successful years of burning garbage on a barrel-grate test incinerator. Laws adopted between 1957 and 1959 aimed at controlling waste disposal prompted the test installation when engineers were asked to experiment with garbage burning for generation of steam and electricity. On a 4-day week schedule, the test unit has been successful in both generation of power and maintaining air pollution within limits. A diagram and photographs of the test unit are included.

**64-0565**
Berne, Switzerland, makes thermal power from waste. Refuse Removal Journal, 7(4):14, Apr. 1964.

In Berne, Switzerland, a municipal incinerator heats a complex of hospital buildings, supplies all the necessary steam used by a large commercial canner of food items, and generates electricity for industrial, commercial, and in-plant use. The problems which brought about this incinerator are also discussed.

**64-0566**
Ceud Mille Failte- at Gowan. Public Cleansing, 54(6):955, June 1964.

The replenished Gowan Refuse Disposal Plant in Glasgow, Scotland, which burns 600 to 800 tons of refuse daily is described. The new specialized equipment added to the plant includes dust extractors, heat exchangers, and a separate trade waste furnace for bulky items. The plant, which utilizes waste heat for electricity, is designed to prevent emission of any grit or fume nuisance. Also, the new General Workshop for vehicle maintenance at Polmadie is described.

**64-0567**
A city fights for its waste.
Brennstoff-Waerme-Kraft, 16(8):408, Aug. 1964.

The city of Frankfurt a.M., West Germany, sued an owner of 26 small apartments who installed a small incinerator in order to use only three instead of ten trash cans. The incinerator was licensed by the state authorities. The court sided with the city on the grounds that many small incinerators add to air pollution and that they might economically hurt waste incinerators operated by the city. The defendant appealed. (Text-German)

**64-0568**
Construction of a waste incinerator plant in the power station Muenster in Stuttgart. Wasser und Abwasser, 105(42):1182-1183, Oct. 16, 1964.

In Stuttgart, West Germany, 330,000 cu m of household waste, 80,000 cu m of industrial waste, 24,000 cu m of street rubbish, and 6,000 cu m of bulky waste accumulate annually which make together about 440,000 cu m of waste with a weight of about 200,000 tons. The major part of the household waste will in the future be burned in the power station Muenster. The incineration will reduce the waste to one third of its weight. The iron parts will be separated from the slag by magnets, compacted into packages and sold. Part of the slag will be used as raw material in the construction industry. Two furnaces are presently being built, a third one is planned for later construction. Part of the heat will be used for generating electricity and part of it will go to a remote heating station. The waste will be driven to the plant by trucks and railways, tipped into a waste storage room with a capacity of 4,000 cu m and brought from there to an intermediate storage room and to the furnaces by two cranes. Electrofilters will clean the waste gases from dust. The waste gases will leave through a 180-m-high chimney. The costs of the incinerator plant are 45 million DM. (Text-German)

**64-0569**
Continuous loading smokeless incinerator. Smokeless Air, 34(130):341, Summer 1964.

Bering Engineering Ltd. of Camberley has announced further improvements in their Kleenaire Smokeless Incinerators. The two larger models with capacities of 9.9 cu ft and 6.4 cu ft have been redesigned to incorporate an extra large loading door to allow them to be refilled when the incinerator is lighted without the emission of smoke or flames. An ash door is fitted to facilitate emptying. The new Mark III range has three main advantages over previous models: (1) The volume of rubbish that can be incinerated daily has been considerably increased with continuous loading; (2) The ease of filling the incinerator makes it suitable for use where women may be required to operate it; and (3) It is feasible to place it under cover fitting a suitable flue to the outlet.

**64-0570**
Diamant, R. M. Modern methods of refuse disposal on the continent. Heating and Ventilating Engineer, 38(449):329-330, 334, Dec. 1964.

The Volund system, a continuous system of refuse incineration consisting of swinging gratebars, is described. From a grate, used for drying and ignition, the refuse passes into a slightly inclined rotating drum, lined with refractories. All combustible matter is burned due to the continuous rotation and the supply of combustion air, with the slack which emerges from the drum falling into a wet extractor. The Lyons Plant, which consists of four Volund furnaces, each with a capacity of 10 tons per hr, is described. It operates completely automatically with a grab collecting the refuse and feeding it into the furnace. Heat is reclaimed from the incinerator, using a boiler, and the steam produced is given off to the municipal power station nearby. The flue gases are cleaned mechanically by multicyclone extractors and two furnaces are each connected to a chimney which is 230 ft high with an upper diameter of 12 ft. The Frankfurt system, where a special thermal power station has recently been constructed, is also described. It is designed to handle 1,000 to 1,100 tons of refuse in 24 hr, although its current operating load is 600 tons in 24 hr. Various methods of refuse disposal are mentioned.

**64-0571**

Dijkshoorn, R. The refuse-incineration plant in Rotterdam. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 12 p.

The development of refuse incineration plants in the Netherlands is reviewed. The construction of a refuse incineration plant must take into account shifts in population. There has been an increase in the calorific value of refuse and a levelling off of seasonal variations. The refuse incineration installation in Rotterdam is discussed, and the determining factors for its general conception, the architectural lay-out, technical equipment, and the utilization of the heat produced are all described. The refuse incineration installation of the city of Rotterdam which had been in existence since 1912 did not meet modern demands and the steady dispersion of dust was a constant nuisance. It was decided again to erect only one central installation. A total of 5,500 ton per week of material is to be incinerated. One-half of the installation is to be inactive during the summer. Two-thirds of the refuse is to be collected by barges and one-third by cars. An installation has been chosen which will allow the maximum utilization of the heat produced during the combustion process. The heat will generate electric current for the public supply network. Plants for district-heating were abandoned due to irregular topography. The construction of the boiler is specially adapted to the incineration of refuse. At the upper part of the fire grate there is a large combustion chamber with two uptakes, where the flue gases are cooled by exposed tubes in the wall. Boiler specifications are provided. Four electrostatic filters are to be used for the best possible elimination of the flue ashes from the flue gas. A 126 hr per week operation is required to meet the increased amount of refuse and rising calorific value.

**64-0572**

Electricity from rubbish. Elektrizitaetswirtschaft, 63(11):380-381, May 1964.

Fifty years ago at the meeting of the Association for Power Plants in Kiel, West Germany, the main speaker, Tillmetz, pointed out that waste incineration is also the concern of power plants. He said that in the year 1914, England, the mother country of waste incineration, had 200 plants in 160 cities. The surplus heat of 65 plants was converted into electricity. The first incinerator plant on the Continent was erected in Hamburg in 1892 and from then on waste incinerator plants increased in number and improved considerably. Tillmetz demanded that incinerator plants be located in the center of a city to save transport costs. The amounts delivered to the plants should agree with the daily capacity of the furnace to avoid expensive storage. Waste must remain invisible on its way from the household to the furnace. The loading of the furnaces is best done mechanically. As far as the economy is concerned, Tillmetz claimed that 1 kg of steam can be generated from 1 kg of waste, if the furnace is mainly fired by coal and only small amounts of waste are added. If steam is delivered to a power plant requiring 6 kg of steam per kWh, at best 167 kWh can be gained from 1 ton of waste. This output is considerably lower when only waste is burned in the furnace. Thus it was realized 50 years ago that waste incineration does not bring any great profits. (Text-German)

**64-0573**

The Essen-Karnap waste incinerator plant. Brennstoff-Waerme-Kraft, 16(2):76, Feb. 1964.

By August 1964 the world's largest waste incinerator will go into operation at the Karnap power station of the Rheinisch-Westfalisches Elektrizitatswerk AG in Essen. Two thousand one hundred and sixty tons of refuse will be burned daily. (Text-German)

**64-0574**

European practice in refuse burning. Civil Engineering, 34(9):40, Sept. 1964.

European incinerator firing methods, according to their present design concepts are summarized. The design of completely water-cooled furnaces with full heat utilization and wide grates is characterized.

**64-0575**

Fischer, F. Possibilities of utilization of energy and residue from incineration. In Proceedings; Second International Congress, International Research Group on Refuse Disposal Essen, Germany, May 22-25, 1962. p.1-22.

A number of possibilities are available to use the energy produced in garbage incineration, but the most important from the economic viewpoint seems to be its use for heating purposes. Consumers must be found and they should be in a position to buy heat produced all the year round. Power production from the heat obtained in garbage incineration is possible but calls for further investment in equipment, unless the steam can be directed to existing power stations. The scoriae obtained as residual material in garbage incineration can be used after adequate processing in road and lane building and also in building stone manufacture. The Riepel-Scherer-Riedel garbage melting process makes it possible to produce a phosphate fertilizer from the scoriae. Garbage incineration is not only a means of disposing of the large amounts of garbage available, but also an economic process due to advanced technology. Efforts must be made in view of developing further possibilities of use and progress, with the assistance of science and technique.

**64-0576**

Fischer, F. The refuse incineration plant in Vienna. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 22 p.

The historical development of a refuse-incineration plant in Vienna is traced from its conception in 1927 to the erection of the city's first composting plant in 1956. The first-grade compost produced meets with a ready market and as a result the composting plant operates without any outside financial assistance. However, it has failed to cope with the refuse disposal problem. In considering incineration, many tests had to be performed to determine the calorific value of the refuse. The most suitable site for the destructor had to be determined. The City of Vienna decided to erect several low capacity plants distributed throughout the town to decrease traffic problems. Sixty percent of Vienna's refuse was at one time burned, but the volume increased to such an extent that the incineration plant was able to handle only half of it. The refuse collectors empty their contents unsorted into the bunker and a grab crane lifts the refuse and drops it into the storage hoppers where it then falls on to the drying grate where it is dried and ignited by radiant heat. The first refuse-incineration plant built in Vienna on the Von Roll system has proved its worth. The performance of the plant with its steam-generating capacity of 1.6 surpasses all expectations. The uninterrupted operation of the plant throughout the night and during weekends ensures a high utilization rate, and the use of the heat finances operating costs and contributes to the capital outlay. A second incineration plant is being planned and much of the experience gained from the first will be utilized. The heat produced during the summer will be utilized to a much greater extent for the generation of electricity.

**64-0577**

Fords use J. Thompson incinerator. Surveyor and Municipal Engineer, 123(3739):39, Feb. 1, 1964.

The incinerator installed by Ford at Dagenham in Britain which can handle up to 40 tons of refuse per 8 hr day of cellulose, packing material, ferrous scrap, and other floor sweepings is described. Sorting facilities are provided along the length of the first elevating conveyor to the primary reception hopper. A magnetic separator removes all of the ferrous scrap. Paper and cardboard removed in sorting is baled. The grates in the incinerator are arranged so that the incoming refuse is swept by hot gases from the burning out grate to lower the moisture content of accrued refuse before it comes to the burning out grate. Adequate quantities of secondary air are provided. Compliance with the Clean Air Act is ensured by scrubbers and at no time will the density exceed Ringleman No. 2 on the Ringleman Scale. It is anticipated that there will be no grit emission.

**64-0578**

Frank, B. Experiences with the incineration of industrial wastes at BASF. Chemie-Ingenieur-Technik, 36(11):1098-1103, Nov. 1964.

The incinerator plant of the Badische Anilin- & Soda-Fabrik AG, Ludwigshafen, has been in operation since October 1960 and has thus far burned 120,000 tons of chemical waste in 24,000 operating hours, i.e. it burned 5 ton per hr producing 30,000 ton of slag and ash. After 20,000 operating hr the tubes coming in contact with the flames showed signs of corrosion. For their protection smooth self-cleaning shields will now be installed. Apart from this restorational work which is presently performed, an expansion of the incinerator plant has become necessary. Since the composition of the waste changed and now comprises almost 50 percent of semifinished plastics vs. 15 to 18 percent in 1960, BASF decided to build two new incinerators, each consisting of a rotary drum, an afterburning chamber (both lined with highly heat resistant corrundum), a waste heat boiler and a joint stack gas duct. The new plant will have a capacity of 50 ton of waste per day at a heating value of 5,000 to 10,000 kcal per kg. The temperature in the combustion chamber is raised to 200 C by the injection of steam. Pulverized, granulated, and viscous wastes are pumped into the incinerator. The bulky waste reaches the incinerator on a conveyor belt. The stack gas is cooled down to 350 C in the waste heat boiler. The heat is used for producing steam. The stack gas leaves through a steel duct which is 120 m high. Costs for the two incinerators with a combined capacity of 50 ton per day will amount 5 million DM. All incinerator facilities combined represent an investment of 20 million DM with about 1 million DM annual operating costs. (Text-German)

**64-0579**
Frank, B. Industrial waste disposal through incineration. Dechema Monographien, 52(895-911):241-258, 1964.

Industrial waste differs greatly in its composition from household waste. The gaseous, liquid, pasty, and solid industrial wastes demand special types of incinerators. In some cases, certain production residues such as sulphite solution and chips of wood can be incinerated together with conventional fuels such as coal, etc. The incineration of waste aims at a considerable reduction of the volume, at freeing the waste from organic matter, and at converting it into a slag containing only inorganic constituents. Organic substances in aqueous solution, and waste gases of widely varying composition, call for additional technical development of the incinerating equipment. The object and purpose of waste incineration should be to produce only residues which can be deposited without contamination of the groundwater. In the present state of technical development the flue gases can be kept free of dust and soot; a certain amount of sulphur dioxide and hydrogen chloride must, however, be accepted. The Badische Anilin & Soda Fabrik AG erected an incinerator in 1960 which is suited for the effective incineration of the multitude of different industrial wastes accumulating at this chemical plant. The incinerator corresponds in its construction to a large extent to domestic waste incinerators; however, the interior of the furnace has been coated with a different material to withstand the higher heating value of industrial wastes. A detailed description of the experiences with the new incinerator is given as well as several illustrations of the major component parts. (Text-German)

**64-0580**
Fulham's new refuse destructor on site of two previous plants. Surveyor and Municipal Engineer, 123(3737):24-25, Jan. 18, 1964.

The scheme used in the reconstruction of the Fulham mechanical handling plant is presented. The plant now provides for satisfactory treatment of refuse under good working conditions by separation, salvage, and incineration. Main concerns in its renovation included the removal and disposal of saleable materials, glass, and 'fines' and the extraction and consolidation of dust. A diagrammatic layout of the plant, and a list of engineers and contractors involved in the reconstruction are given.

**64-0581**
Gerhardt, R., and H. Ermer. Planning and construction of the incinerator plant in Neustadt Holstein, Germany. Staedtehygiene, 15(1):5-13, Jan. 1964.

The city of Neustadt, Germany, has a population of 15,000. In 1962 the city was confronted with the problem of disposal of the increased amounts of waste. The available sites were all filled to capacity. A composting of waste was not feasible because the city has no use for compost as fertilizer. The decision was made to build an incinerator plant with a capacity of 30 ton per day. The trucks bringing the waste will be emptied into a storage chamber which is kept under reduced pressure. A crane will bring the waste to the loading funnel of the incinerator and via a hydraulically operated loading device, the waste will reach the grate of the furnace. An oil burner will aid the incineration blown under the grate. The flue gases will leave the combustion chamber with a temperature of 900 or 1,100 C, depending on the heating value of the waste. In a heat exchanger the temperature of the flue gases will be reduced to 350 C, with a filter subsequently cleaning the flue gases which escape in the air through a double-walled chimney. The total investment costs for the plant are estimated to amount to about 1 million DM. The operating costs will be 24.60 DM per ton of waste. The major constituent parts of the plant are described in detail. (Text-German)

**64-0582**
Haller, R. The clarification and incineration plant in Ebingen, West Germany. Wasser und Abwasser, 105(38):1049-1050, Sept. 18, 1964.

In Ebingen, West Germany, a clarification plant was built comprising four settling tanks, an accelerator, cyclator, dehydrator, and an incinerator. In 1961 a trash preparation facility was added. The household trash is crushed in a hammer mill and the iron parts are removed from the waste and compacted into cubes weighing about 30 to 40 kg. The crushed waste is either incinerated or composted. The dehydrated sludge from the settling tank can be added to the waste in the furnace. Since January 1964, flammable industrial waste such as packing material, cardboard reels, and plastic covers has been incinerated. This material has yielded much higher stack gas temperatures so that an adjustment of the cooling and filtering system became necessary. The furnace operates 24 hr a day at a mean temperature of 700 C. Sludge containing 16 percent solids is incinerated at the rate of 3.5 cu m per hr (or of 1.2 cu m per hr in terms of 50% solids). (Text-German)

**64-0583**
Kachulle, C. The planning of plants for the elimination of solid waste (Part I). Wasser, Luft und Betrieb, 8(5):267-270, May 1964.

The development of incinerator plants is discussed. The first incinerator plants (which did not utilize the heat produced) were put into operation in England (1874) and the United States (1885). The latter now has in operation 500 such plants. The composting of waste has its origin in China where 3,000 years ago laws were passed ordering the composting of all waste. But an increasing amount of inorganic substances among the waste nowadays makes the composting more difficult, so that we have to turn more and more to incineration. The 'Workgroup Ruhr for Collecting, Eliminating and Utilizing Waste and Rubbish' has worked out eight guidelines to a more efficient waste incineration which are cited at full length. They call for cooperation between engineers, scientists, and municipalities in tackling waste elimination problems and projects, for the development of new incineration methods, for experimental plants designed to provide experience with new methods, for limitation of construction costs, etc. The Rhein-Westphalian Electric Company (RWE) received an order to develop experimental incinerator plants for burning domestic waste. Over a period of 2 years the cities concerned collected data on the amounts of waste accumulating, its weight, and its volume. The RWE investigated the grain size distribution, water content, amount of organic substances, and the heating value of the waste. The collected data convinced the Workgroup Ruhr to recommend the incineration system I used in Essen Karnap. A brief description of this system is given. (Text-German)

**64-0584**
Kachulle, C. The planning of plants for the elimination of solid waste (Part II). Wasser, Luft und Betrieb, 8(6):359-362, June 1964.

The investment and operating costs of an incinerator plant with a capacity of 2,160 tons per 24 hr, calculated on the basis of January 1962 prices, are given. The investment costs plus the costs of financing (16 year loan) plus repair costs are 6,450,000 DM. About 3.2 million DM will not be covered by the gains from the sale of heat and scrap and must be raised annually by the municipalities. These results are considerably lower than the values estimated by the Workgroup Ruhr--investment costs 15,000 DM per ton per day and 12 to 13 DM per ton balance. Furthermore, the operation of an experimental plant over a period of several years had been just recently terminated with positive results. The Rhine Westphalian Electric Company designed this plant for a capacity of 100 to 120 tons per day according to system II of the plant in Essen Karnap without, or with negligible, heat utilization. The differences between incinerator plants in the United States (no attempts at heat utilization) and Europe (heat utilization, requiring proximity to residences and expensive architecture) are briefly outlined. A cost comparison (Table 2) between plants without heat utilization (Philadelphia) and those with heat utilization (Vienna) indicates that the sale of heat is hardly worth the trouble. (Text-German)

**64-0585**
Kallenbach, K. A waste incinerator plant with roller grate burner for the City of

Hagen. Brennstoff-Waerme-Kraft, 16(8):406-407, Aug. 1964.

The City of Hagen, West Germany, plans the construction of a waste incinerator for 400 tons per day. Although the prime interest is the incineration of waste, the heat produced will be sold commercially. Since the plant is located in an urban area, special attention is paid to the problem of storing the waste and removal of the slag. Electrofilters and a 70-m-high chimney are provided. Iron is collected magnetically from the slag, compressed and sold commercially. Construction time is estimated to be 20 months. (Text-German)

**64-0586**
Kampschulte. The present state of waste incineration in Hamburg. Staedtehygiene, 15(4):84-86, Apr. 1964.

Hamburg, the city where the first incinerator plant of the continent was put into operation in 1896, has gradually enlarged and streamlined its incinerator plant built in 1931 by the addition of three Von Roll furnaces (capacity 200 tons of waste per 24 hr), making a total of five. An old incinerator plant which had been in operation for 48 years has been closed. Because of the satisfactory experiences with the first two furnaces the three new ones are also equipped with slag generators. The waste heat boilers each have a capacity of 20 tons of steam per hour, a test pressure of 21 atmospheres at 350 C which is kept constant with automatic regulators. Because of the three new furnaces the fourth turbogenerator set can be put in operation so that there are now two sets with 1,000 kw per 6,000 V each and two sets with 6,400 kw per 6,000 V each. Although the plant is equipped with electrofilters, the chimneys (31 m) are not high enough. Dust pollution occurs in unfavorable weather. Seven photographs illustrate the exterior and interior appearance of the plant. It is expected that 1.5 million cu m of waste will now be burned annually and approximately 50 million kwh of electricity generated. (Text-German)

**64-0587**
Kaupert, W. Waste incineration in large and small furnaces. Staedtehygiene, 15(5):109-111, May 1964.

If incineration is to take place in a small furnace, the waste must be crushed first, a requirement generally not necessary for large furnaces. Only if the accumulating amount of bulky wastes is great, as in large port cities, is a crushing process necessary. In both small and large furnaces, the most important part of the incinerator is the grate. The commonest types of grates and the outstanding characteristics of each are tabulated. Brief descriptions of the traveling grate, the roller grate, the Von Roll grate, and the Martin grate are given, most of which are used in large furnaces. A small incinerator plant without heat utilization has been erected in Gluechstadt, Germany. Another small incinerator plant will go into operation in Neustadt. The mode of operation of these furnaces is explained. (Text-German)

**64-0588**
Kmoch, H. Automatic control of waste incinerators. Brennstoff-Waerme-Kraft, 16(8):402-403, Aug. 1964.

The necessity for automatic controls in waste incinerator plants is discussed. In two schematic drawings of plants, the measuring and sampling points are shown, together with the location of the control equipment such as valves, etc. Transducers and actuators are energized by compressed air. (Text-German)

**64-0589**
Lytham St. Annes refuse plant modernized. Surveyor and Municipal Engineer, 124(8775):40, Oct 10, 1964.

The new features of the modernized £ 100,000 refuse disposal plant at Lytham St. Annes are described. The new plant was made necessary by the increase in population, the rise in the yield and bulk of the refuse as well as the age of the existing plant. The capacity of the new plant is 65 tons which could be increased to 85 tons a day. There are 36,300 persons in 12,672 homes with a refuse yield of 14,491 ton per year in the area. The 120 cu yd reception hopper handles the light density refuse without choking. The mechanical handling and screening plant includes an electromagnetic separator for the removal of cans which are baled in a press. The residue from the screening plant is incinerated in a 4-cell Heenan Trough Grate Unit.

**64-0590**
Modern refuse incinerator plants. Public Cleansing, 54(2):702, Feb. 1964.

European incineration in light of the quantity and characteristics of European refuse and the requirements of waste heat utilization is analyzed. A steady increase in weight, volume, and heat potential of refuse is noted. The characteristics of refuse seem to be governed by locality, season, and the local economic situation. The historical development of the Von Roll-type system, discerning a trend toward maximum heat utilization and increased furnace capacity, is traced. The energy producing power of refuse is discussed. Incinerators connected to a network of large capacity utilizing steam, are recommended. The incinerator of Berne, Switzerland, is discussed.

**64-0591**
Mueller, W. The waste incinerator plant of the City of Ludwigsburg. Staedtehygiene, 15(12):266-268, Dec. 1964.

On August 17, 1964, construction was started on the waste incinerator plant of Ludwigsburg, West Germany. It will supply electric power and remote heating. The two furnaces each have a capacity of 200 ton of waste per day. Since the plant is located in a residential area, all precautions are taken to avoid air pollution and odors. The air for the furnaces is taken from the waste storage bunkers, thus reducing the air pressure in them. A crane dumps the waste into a water-cooled input shaft which ends in a drying grating. The hydraulic staircase grating is supplemented by mechanical pokers. The slag is dumped into a water basin and then stored. The furnace temperature does not exceed 1000 C. Each boiler produces 23 ton of steam per hr at 45 atmospheres and 450 C. Electrofilters and a 100-m-high chimney effectively control smoke and dust problems. Total electric power will be 9 million. (Text-German)

**64-0592**
New all-purpose refuse incinerators demonstrated. Surveyor and Municipal Engineer, 124(3777):61-62, Oct 24, 1964.

Two incinerators were demonstrated at an exhibition sponsored by the National Society for Clean Air in October 1964 by burning all of the rubbish left over from the displays as well as refuse brought in from the outside, such as bags of animal bones. The two sealed flame waste disposal units operated throughout the 3-day meeting to demonstrate the guaranteed smokeless incineration of any refuse. The double sleeve stack incorporates a mixing chamber which coverts the preheated smoke-air mixture into a combustible gas reducing the gas comsumption in the afterburner to a minimum. The unit can use bottled or standard supply gas for the afterburner as well as an oil-fired system if required. The whole of the front may be opened to take bulk refuse or an auxiliary door may be used for smaller items. An estimated 45 minutes is required to dispose of a load of refuse containing rubber, plastics, vegetable, and animal matter with no smoke and only a small amount of dry ash. The incinerators are built by Universal Machinery and Services Ltd.

**64-0593**
New disposal plant for Fulham. Public cleansing, 54(3):776, Mar. 1964.

A new separation and incineration plant in Fulham, England, is described. Some of its features are a hydraulically operated regulatory beam in the refuse reception hopper; a dust extraction plant; an elevator conveyor that transfers crude from hopper to a rotating screen which separates the ash and other fine material from the refuse; an electrically driven bottle pulverizer; two waste heat boilers; and metal and paper balers.

**64-0594**
New £ 1-½ m. refuse disposal plant for Glasgow. Surveyor and Municipal Engineer, 123(3751):21-22, Apr. 25, 1964.

A description of the site, buildings, and operation of a new plant for refuse disposal in Glasgow is given. Special emphasis is on removal and baling of paper, electro-magnetic recovery of tin and ferrous metals, capture and consolidation of dust and cinders, and final incineration. The incinerator units and the separate trade's wastes incinerator with associated waste heat boiler are discussed in detail.

**64-0595**
New refuse plant for Lytham St. Annes. Public Cleansing, 54(12):1314, Dec. 1964.

The operation of a new incineration plant in the British borough of Lytham St. Annes is described. The plant extracts and bales all salvageable material. The plant, which now has four conveyor-fed incinerator cells, allows for the addition of two new incinerator cells, dust trap, and chimney to cope with the expected increase in the production of refuse.

**64-0596**

Ochs, H. J. Installation of air filters in incinerator plants. Wasser, Luft und Betrieb, 8(9):535-537, Sept. 1964.

Special filters were developed between March and July 1962 for an incinerator plant in Hamburg, Germany, to remove the large amounts of dust present in the incinerator air. Tabulated data shows that the dust content of the air used for incineration is between 3.1 and 34.5 mg per cu m. After determination of the particle sizes of the dust, an automatic, metallic rotary air filter of the class A coarse filter, whose upper particle size limit is 8 micrometers, was installed. The apparatus is illustrated. To clean the filter, the wetting agent container was equipped with nozzle connections, which pushed the wetting agent under pressure through the filter cells. The wetting agent absorbed the dust and was then removed through the bottom of the wetting agent container, passed through a sedimentation vessel and a filter was subsequently recirculated. Since the dust stream has a pH of 8, a special surfaces treatment was provided for the rotary filter elements. (Text-German)

**64-0597**

Palm, R. Conventional methods of incineration. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962. p.1-18.

Efforts should be made to bring the garbage without previous treatment, drying, or sorting directly into the feeder of the incinerator, but it is advantageous to allow the garbage to settle one or two days, even when it is very wet. Hydrocarbon gas is then formed that facilitates ignition of damp garbage. Drying grates should be installed ahead of the incinerating grates. Carbonization gas is produced from dry garbage at temperatures of 250 to 300 C. For this reason, garbage could be ignited without difficulty, but in order to secure total incineration and to deal with slag, special efforts are required. As soon as incineration temperature is too high, it must be directed to the cold combustion air flow. If drying through top heat is too intense, the surface of the garbage might tend to form a crust. Bitumen thus formed clogs together when they are not gasified. Crust formation can be avoided by increased grate movement, heat passage can be improved during heating up, and total combustion can be bettered by increasing the height of the layers by means of a retention pendulum, by means of pits or drums. Various incineration systems are briefly described: the Horsfall incinerator, the Boussange kiln, the Heenan and Froud kiln, the Davor plant, the Oecare kiln, the Venien kiln, the Martin repulsive grate, the Volund system, the Von Roll incinerator, and the Dusseldorf system.

**64-0598**

Practical experience in incineration. Public Cleansing, 54(6):939, June 1964.

Two papers on waste-heat utilization from incineration are summarized. The development and operation of the Rotterdam electricity-generating boiler plant is described. The attached power station is equipped with three turbo generators of 7,000 kw each. The operation of the Vienna plant, which uses the Von Roll system to produce heat, is detailed. The plant also has an emergency power plant which generates electricity in case of failure in the city's main supply.

**64-0599**

Rasch, R. Third waste technology meeting in Stuttgart, Germany. Tonindustrie-Zeitung und Keramische Rundschau, 88(6):139-140, 1964.

On February 21, 1964, a waste technology meeting was held at the Institute of Technology, Stuttgart, Germany. The possibilities and limits of waste incineration were discussed. Although waste becomes more voluminous, its weight per person and per-year decreases. The heating value, considered in relation to water and ash free substance, decreases too. The decreasing amount of coal ash among the waste is disadvantageous to the melting behavior of waste ash. The melting point of slag was found to lie between 850 C and 1,200 C in Europe and 1,450 C in the United States. The ash from waste incinerator plants in Duesseldorf and Stuttgart-Muenster, Germany, is mentioned briefly. (Text-German)

**64-0600**

Rasch, R. Waste incineration and slag utilization. Tonindustrie-Zeitung und Keramische Rundschau, 88(14):317-325, 1964.

Various aspects of waste incineration are reviewed. Waste is difficult to treat because it is so heterogeneous in composition. Its constituents vary greatly in size. A separation of the waste according to size prior to incineration proved to be very efficient. By this method the bulky waste is retained in a sieve and passed to a shaft furnace. In a second sieve, the medium sized waste constituents are retained, crushed and mixed with the residues from the shaft furnace. They are burned in a shaking grate furnace. A table shows the constituent parts of the waste in percentage by weight in the countries of Germany, England, the Netherlands, and Switzerland. The various types of incinerators, with and without grate, are reviewed and illustrated. The slag remaining from incineration is rich in carbon which makes a sintering process possible. A table showing in detail the various components of slag is given. Slag from waste incineration contains metal, glass, ash, etc., in varying quantities. For sintering the slag, the sinter aggregates are used as additives with the Lurgi sinterband. Sintered slag of good quality can be used instead of pumice in the production of construction material. (Text-German)

**64-0601**
'Refumatic' Incinerator. Public Cleansing, 54(7):1045, July 1964.

The British-manufactured Refumatic is a fully automatic incinerator especially designed for blocks of flats. Installed at the base of a vertical chute system, the incinerator comprises a main combustion chamber, a smoke burn-off chamber, a water-wash chamber which collects the fly ash, an induced draught fan which withdraws the waste gases from the water wash and discharges them directly to the chimney, and a control system.

**64-0602**
Refuse incineration and steam raising. Surveyor and Municipal Engineer, 124(3777):46, Oct. 24, 1964.

Steam raising capacities in Great Britain from the incineration of refuse are inadequate. Initial and maintenance costs are excessive in relation to the value achieved. Two interesting but conflicting American theories on this idea were presented. It was generally agreed that the quantity and nature of the refuse burned varies with the standard of living. These qualities affect the rate and the way of burning and, therefore, the products of combustion. Atmospheric pollution as a result of incomplete combustion is discussed.

**64-0603**
Refuse incineration for power production at Munich. Surveyor and Municipal Engineer, 124(3782):29, Nov. 28, 1964.

Refuse incineration used for power production reduces the coal shortage and tipping problems in Munich. The plant designed to burn pulverized coal and refuse in two separate furnaces of high pressure steam generator is described. The problems and reasons for two separate furnaces are discussed including design and arrangement of heating surfaces, temperature and percentage of components, and efficiency. The operation of the plant is sketched from reception to discharging of the ash.

**64-0604**
Refuse incineration in the Netherlands. Surveyor and Municipal Engineer, 123(3754):32a-32b, May 16, 1964.

The Netherlands, forced to turn from composting to refuse incineration, examined available systems. Some form of heat recovery and utilization was demanded, but separation of recoverable materials was not considered necessary. Seasonal variation in the nature and quantity of refuse to be handled was reviewed. Generation of electricity was decided upon for heat utilization and the construction of boilers and power station explained.

**64-0605**
Refuse incinerator designed for a charge of 2 x 6 tons per hour. Wasser, Luft und Betrieb, 8(7):438-439, July 1964.

An incinerator is described in which the weighed refuse is deposited through seven refuse locks with automatic swing gates into the refuse reserve bin. One of the locks, which is used for bulky refuse, has an impact crusher connected to it. A grabbing crane serves both the impact crusher and feeding hopper. Downshafts supply the refuse to the incinerator and incineration proceeds by means of several travelling grates designed in a steplike arrangement. The generated heat is diminished by a waste heat boiler situated above the incinerator chamber and the smoke gas escapes by way of an electrofilter through the chimney. A part of the preheated air is reused as incineration air and the rest escapes through the chimney. A return for the smoke gas is provided to maintain the temperature at the incinerator exit when necessary. The slack, which is formed at the bottom of the vessel, is broken up and transported over a magnetic drum to a high bunker. The metal separated by the magnetic drum is transported to the ribble press (Schottpakertierpresse). A schematic diagram is provided. (Text-German)

**64-0606**
Refuse smelting facility at the Volkswagen plant. Brennstoff-Waerme-Kraft, 16(2):76. Feb. 1964.

The Volkswagen plant plans to install a smelting furnace operating on the FLK-principle (flame chamber process) to treat 5 tons per hr of all kinds of refuse. In the FLK-process the burning material itself furnishes the furnaces lining, thereby allowing temperatures of operation above the melting point of slag. Refuse with low heat content can be used without additional fuel. The flue gas is free of dust and smoke. The heat obtained is used in the central heating system of the plant. (Text-German)

**64-0607**
Report on the exhibit of chemical apparatus (ACHEMA), 1964, pertaining to the field of sanitation. Staedtehygiene, 15(12):282-286, Dec. 1964.

The exhibit of chemical apparatus, taking place in Frankfort/Main, West Germany, in intervals of 3 years, is the world's largest of this kind. As far as the solid waste problem was concerned, the 1964 ACHEMA stressed the theme 'Waste Incineration'. In this field a tendency towards the revolving cylindrical furnace as the preferred incinerator could be observed. It is ideally suited for incineration of all kind of waste, including sludges, as well as for containers of various shapes and sizes. (Text-German)

**64-0608**
Spitzer, E. F. European incinerators. American City, 79(11):85, Nov. 1964.

Incineration in plants in Paris, Vienna, Rotterdam, Frankfurt, and Amsterdam is discussed. A general characteristic of European plants is the utilization of steam to produce heat and electricity. A change in the quantity and quality of European refuse is noted.

**64-0609**
Stabenow, G. European practice in refuse burning. Presented at 1964 National Incinerator Conference, New York, May 18-20, 1964. American Society of Mechanical Engineers. 9 p.

The practice and type of design in some of the European municipal incinerators are described and special attention is given to the design of grates. The incinerators include: the Volund incinerator at St. Ouen (Paris), the Martin incinerator at Munich, the incinerator at Duesseldorf, the Von Roll incinerator at Hamburg, the Karnap installation at Duesseldorf, the Esslingen incinerator at Stuttgart, and the Semler incinerator. Data is given on amount of refuse per capital, analysis of refuse, and heat recovery. Traveling, reciprocating, reverse acting Martin-type, and multiple rotating drum grates are illustrated and their advantages and disadvantages discussed. It was concluded that magnetic separation of iron from refuse before the furnace is not desirable as case, wire, and springs promote better aeration for combustion. Grates should be kept as wide as practicable for a minimum refuse bed thickness. Practically all European units with capacities of 5 ton per hr and over were furnished with waste heat boilers and heat utilization is, in most cases, for power generation in combination with municipal district heating systems. The rigid European dust emission specifications of 0.15 to 0.25 lb per 1,000 lb gas at 50 percent excess air make the use of electrostatic precipitators mandatory. Auxiliary ignition burners are used for small installations only.

**64-0610**
Test on incineration in Great Britain. Public Cleansing, 54(6):978, June 1964.

Simon Handling Engineers, Ltd. of Great Britain has experimented with the Morse-Boulger fully automatic incinerators used in the United States to test how effectively British refuse would burn. Results indicate that there is an advantage in pulverising refuse before incineration and that the quantity of ash produced in the United Kingdom will not hamper satisfactory operation of the incinerator.

**64-0611**
Vienna's incineration plant. Surveyor and Municipal Engineer, 123(3754):32-32a, May 16, 1964.

Transportation problems and the desire for complete heat utilization forced Vienna to erect a number of lower capacity incinerator plants rather than one larger one. The first of these plants was built according to the Von Roll System. Generation of electricity, automatic cleaning of the flue, and use of waste oil are described. Problems created by briquette ash and some possible solutions are discussed.

**64-0612**
Waste burning and sintering facility in Berlin. Brennstoff-Waerme-Kraft, 16(9):409, Aug. 1964.

In Berlin-Ruhleben a waste burning facility is being built by the municipal authorities. At a cost of 71 million DM it will convert 2,000 tons per day of refuse and sewage into 1,000 tons of sintered additives for concrete. Scheduled for completion in 1968, it will process about one-half of the total daily refuse of Berlin. (Text-German)

**64-0613**
A waste incinerator for Darmstadt. Brennstoff-Waerme-Kraft, 16(8):408, Aug. 1964.

The incinerator plant in Darmstadt, West Germany, now under construction, will handle 200 tons of waste per day. The waste need not be sorted or crushed. The grate is supplied by the Von Roll AG in Zurich, the boilers by MAN. The waste is burned at 1,000 C and waste gas filters are provided. (Text-German)

**64-0614**
Weber, E. Dust and waste gas output of a domestic waste incinerator. Staub, (6):210-216, June 1964.

A domestic waste incinerator (volume of combustion chamber 400 liters) installed in the basement of an apartment house with 40 units has been investigated with respect to its dust and waste gas output. The process of combustion has been closely observed and 22 measurements of the dust contents in the waste gases have been made at intermittent days. The amounts and the temperature of waste gases leaving the chimney have been constantly checked and the weather conditions have been observed. The mean value of emitted dusts was found to be 0.238 g per cu m of waste gas which was above the value permitted by the VDI (Association of German Engineers) recommendations. Experiments with a choke valve installed in the chimney showed that no lasting decrease of the dust contents could be achieved. The installation of a scrubber became necessary, which reduced the dust contents effectively to 0.0289 g per cu m of waste gas. Various tables give a detailed listing of all values obtained in measurements with and without choke valve and scrubber. The pungent odors arising at the beginning of the incineration have been largely eliminated through giving the incinerator a heating-up period of about 90 minutes to achieve a high temperature before loading it with waste. (Text-German)

**64-0615**
Winnacker, K. Elimination of industrial wastes as a technological task. Chemie-Ingenieur-Technik, 36(1):1-8, Jan. 1964.

Examples taken from the chemical industry illustrate how pollution problems were solved. Methods of cleaning polluted water and air are thoroughly discussed. For incineration of chemical waste, special incinerators are being developed. A diagram is given of the incinerator used by the Badischen Anilin- & Soda-Fabrik AG., Ludwigshafen, Germany. The waste goes first to the drying grate and then to the main grate. The slag residues are discharged by a conveyor belt. The furnace also has a chamber for the incineration of liquid waste. Another possibility for incinerating chemical waste is the rotating drum furnace used by the Dow Chemical Company, which is suited for burning liquid and solid waste. The rotating drum is lined with a fireproof material. The Farbwerke Hoechst, Germany, experimented with a melting chamber furnace. An illustration of this furnace is given. (Text-German)

**64-0616**
The world's largest waste incinerator plant. Chemie-Ingenieur-Technik, 36(2):167, Feb. 1964.

The world's largest waste incinerator plant is presently being built by the Deutsche Babcock & Wilcox-Dampfkessel-Werke AG, Oberhausen. Located in Essen-Karnap, it is designed and will be operated by the Rheinisch-Westfaelische Elektrizitatswerk AG for the generation of electric power. When completed, the plant will incinerate 2,000 tons of waste per day. (Text-German)

**64-0617**
Wotschke, J. Universal waste removal and its realization by the flame chamber smelting process. Brennstoff-Waerme-Kraft, 16(8):383-392, Aug. 1964.

In a general discussion on waste removal problems it is pointed out that it is desirable for economic reasons to have one process by which all kinds of refuse can be treated with the least amount of preprocessing. The flame chamber smelting process (FLK-process) is said to fulfill these requirements. The basic idea is to raise the operating temperature to about 1,250 C at which combustible material is vaporized and non-combustible material is melted and drained. The refuse itself is used to protect the furnace walls from the high temperatures. The energy consuming process of vaporization forms a heat protective layer. The flue gas is remarkably free of dust since it must pass through the thin film of molten slag forming on the surface of the burning refuse. Some theoretical background on the FLK-process is presented, together with some preliminary experimental results. Schematics for a FLK-furnace for 1,000 kg per hr and photographs of a prototype under construction are also given. (Text-German)

## INDUSTRIAL WASTES

**64-0618**
Abernathy, A. R. Measurement of microbial degradation of sulfonated lignin. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University, Engineering Extension Series No. 117. p.602-615.

A comparative study was made of six methods of measuring microbiological degradation of lignins. The six methods were: (1) direct photometric; (2) indirect photometric; (3) gravimetric; (4) chemical oxidation; (5) methoxyl determinations; and (6) elemental analyses. Marasperse CB was the lignin sulfonate used. It was found that the degree of lignin removal by microbial cultures depends upon the method used to evaluate lignin concentrations. No one of the presently used tests is adequate for calculations of lignin removal or destruction. When lignin sulfonate is the only carbon source present, microorganisms do attack it. Most attack seems to occur at the side chain. The preferred tests are the Folin-Denis test and the COD test. Ultraviolet absorption is useful to check for destruction of aromatic rings. New analytical methods are needed.

**64-0619**
Alyamovskiy, V., et al. Wasteful burning of rubber plant products. In USSR industrial development. Soviet chemical industry. No. 82 (JPRS:19,863). Washington, U.S. Department of Commerce, Joint Publications Research Service, June 1963. p.1-2.

Poor utilization of industrial wastes in a rubber tire plant results in significant economic losses. Only 40 tons out of 170 tons of burnt rubber were processed in one plant. If the rubber had been utilized completely, it would have resulted in a saving of 100,000 to 120,000 rubles. Other methods of utilization of rubber waste would result in a saving of 260,000 rubles. Examples of utilization of waste in other industries are discussed. (Translation of an article in the Russian language newspaper Izvestiya, Moscow, Feb. 20, 1963) (Defense Documentation Center AD-412 089)

**64-0620**
American Sugar Cane League. Cane sugar industry (Industrial waste guide). Public Health Service Publication No. 691. Washington, U.S. Public Health Service, 1963. 19 p.

Available information on the nature, types, and amounts of wastes produced by the sugar cane industry, and the methods which have been developed and used to overcome or minimize the harmful effects of waste effluents are summarized. The magnitude of the problem, description of process, volume and character of wastes, pollutional effects, remedial measures, sampling and analytical procedures are presented. A simplified flow diagram for raw cane sugar manufacture is given. There are several sources of waste waters leaving cane sugar factories. Of these sources, only two are major: cane wash water; and floor washings. Waste water from cane wash plants is very high in BOD and is produced in large quantities. Special impounding basins or treatment methods are required for stabilization of this type of waste. Floorwashings, boiler blowdown, and soda and acid wastes are small in volume but fairly high in BOD. This material is usually handled by detention basins.

**64-0621**

Amero, C. L. Continuous centrifugal dewatering of waste sludges. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.139-151.

A centrifuge is described. Basically, it consists of a two-member rotating element, bowl, and conveyor, completely enclosed by a stationary housing properly baffled to prevent remixing of the separated solids and liquids which discharge from opposite ends of the bowl. A typical centrifuge is shown in cross section in a figure and a cutaway view in another. The theoretical basis for this activity is given in a formula. The settling velocity of solids and, therefore, the clarifying capacity of a given size of centrifuge operating at a given speed, will increase with greater particle size, increasing density difference between solid and liquid, and decreasing viscosity of the liquid carrier. Greater radial acceleration of the particles will also increase the clarifying capacity of a centrifuge. Acceleration can be increased either by increasing the speed or the size of the unit. Actual performance can not be predicted by these theoretical factors which are guides. The use of solid bowl continuous centrifuges in domestic and industrial waste sludge handling has been increasing. Several examples are cited: North San Mateo, California; Concord, California; and San Leandro, California. A summary of test results at the primary treatment plant in Amherst, Massachusetts, is presented in a figure. The economic advantages of this method are stressed.

**64-0622**

Atkins, P. F., and O. J. Sproul. Feasibility of biological treatment of potato processing wastes. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.303-316.

The rural areas where most potato processing plants are located frequently have no waste treatment plants or, if they do, the addition of this organic content waste may seriously overload them. The feasibility of biological treatment for a combined potato processing waste from a plant using lye-peeling has been studied. Data on waste characteristics from these plants were obtained. Detailed studies were made of the complete mixed activated sludge method and of the possible use of the contact stabilization method. Two surveys were made of the processing plant: one in October 1962; and the other in July 1963. Changes made within the plant between the two surveys resulted in a 50 percent reduction in plant BOD, a 30 percent reduction in suspended solids, and a reduction of about 10 percent in water usage. Since lye-peeling produces wastes with a pH of 11.7, two approaches were taken in the biological treatment feasibility studies: one of treating straight potato processing waste; and the other of pretreating the waste with sulfuric acid to reduce the pH to a more favorable range of 8.0. The results of these studies are presented in two tables. It appeared that effective BOD removal (98%) was possible by a completely mixed activated sludge system, that pH adjustment was not necessary, and the detention times were fairly long (15 to 20 hr). Further studies conclusively demonstrated that potato processing wastes can be treated by a completely mixed activated sludge system at a solids level of 4,000 mg per liter and a detention of 6 to 8 hr. BOD reductions of 95 percent or higher can be expected. The contact stabilization process appears feasible and should be studied further.

**64-0623**

Batz, M. E. Deep well disposal of nylon waste water. Chemical Engineering Progress, 60(10):85-88, Oct. 1964.

Subsurface disposal of concentrated nylon waste is efficient and is drawing increased attention. The Chemstrand Company nylon plant at Pensacola, Florida, is the largest of its kind in the world. In a period of 10 years, the plant production was tripled. The problem of keeping waste treatment abreast of production became difficult. The United States Geological Survey conducted subsurface experiments with nylon waste disposal. An experimental well was drilled in a limestone formation for the experiments. Research was also conducted on the nature of the waste. Surface treatment for settling and aging would still be necessary in order to maintain a pH below 5. The well casing was API steel to prevent pollution of potable water. A complete stainless steel injection system was installed. Two monitor wells were drilled nearby. When turbidity is greater than 10 ppm, the system is shut down to allow additional settling. It is not necessary to pretreat or filter the waste. This system is very economical and dependable. The capital and operating costs are about one-tenth that of the bio-oxidation system. Additional data and illustrations are contained within the report.

**64-0624**
Baumgartner, D. J., and C. F. Walters. Treatment of undiluted human waste by the activated sludge process. Fort Wainwright, Alaska, Arctic Aeromedical Laboratory, Mar. 1964. 20 p.

An activated sludge system was operated to confirm field investigations which indicated that a 423-gal recirculating activated sludge system could adequately treat the undiluted human wastes from ten men for 6 months and provide an effluent acceptable for use as a flushing fluid. In addition, the level and the effects of overloading were noted. The effect of high pH on odor production was observed, and the importance of pH control between 6 and 7 was demonstrated. The feed COD of 44,000 mg per liter (BOD = 21,000 mg per liter) was reduced by about 90 percent and the estimated water savings for toilet flushing was estimated at greater than 90 percent.

**64-0625**
Belokon, A. Production of metatoluidine from wastes. In USSR industrial development. Soviet chemical industry. No. 72 (JPRS:19,362). Washington, U.S. Department of Commerce, Joint Publications Research Service, May 1963. p.27-29.

Metatoluidine, an essential dye component for movie film color, can be produced from material previously thought to be waste. By utilization of this waste material, metatoluidine production cost is reduced to one-third of the previous cost. (Translation of an article by A. Belokon in the Russian language newspaper Rabochaya Gazeta, (Workers' Gazette), Kiev, Feb. 8, 1963) (Defense Documentation Center AD-408 897)

**64-0626**
Black, R. J. Combined disposal of sewage sludge and refuse. In Solid waste disposal and municipal equipment 'rental'. New York, Buttenheim Publishing Corporation, June 1963. p.36-39.

Combined disposal of sewage sludge and refuse by sanitary landfilling, incineration, or composting can result in worthwhile savings to the community, if these facilities are located so as to minimize hauling costs. This may be impossible to accomplish in some local situations. Only an evaluation of the possible satisfactory alternatives, including costs, can provide the information needed to choose the disposal methods best suited to local conditions. The composting of digested sewage sludge with sawdust and shavings is more economical than other methods of sludge processing under favorable climatic conditions. Researchers report that the use of digested sewage sludge to make artificial topsoil over completed sanitary landfills in New York cost only a third as much as importing natural top soil. Some sanitary landfill operators bury sewage solids, bar screening, grit and dewatered digested sludge along with the refuse.

**64-0627**
Bramer, H. D., and R. D. Hoak. Zeta potential and sedimentation practice. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.977-885.

The development of an instrumental means for determining and controlling coagulant dosages in the treatment of industrial wastes by sedimentation is reported. The processes of interest include the clarification of suspensions of inert solids, of slurries produced in neutralizing waste acids, and of oil suspensions. Suspended particles of relatively large size and very dense chemical precipitates are of interest rather than the colloidal particles and light flocs of concern in water purification. Jar tests and electrokinetic measurements are currently used to evaluate coagulants. Jar tests try to duplicate plant practice in laboratory tests of various coagulant dosages and flocculation techniques; results are evaluated in terms either of residual suspended solids after a settling period or of resulting sludge density. Electrokinetic measurements are used to determine the magnitude and nature of the charges on the surfaces of the suspended particles, and then to evaluate coagulant dosages by the extent to which the particle mobilities are neutralized. Results are expressed in terms of particle mobilities or of average zeta potentials. These two techniques have proved useful in many applications but of little or no value in others. Several different systems have been tried. A readable electrical signal can be obtained from a suspension in which the particles are moderately charged. Getting a signal that is reproducible, interpretable, and independent of solution pH or conductivity is, however, difficult. The system reported consists essentially of two electrodes of similar metals connected to a high impedance DC amplifier with an open-loop gain of about 1,000. Several traits of the apparatus have been carried out with electrodes placed directly in process streams in water purification and waste treatment plants. The readings were often directly related to observed changes in either process variables or in the composition of the plant influents. The readings were not consistently interpretable, however, in terms of measurable variations in the plant effluents. The failure to measure other variables, principally, pH, probably accounted for the inconsistencies. The instrument seems to be useful as a laboratory tool rather than for in-line measurements at present.

**64-0628**
Brink, R. J. Operating costs of waste treatment in General Motors. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.12-16.

The cost of treating industrial waste varies in the industry and within the industry, for in any particular plant there may be oil wastes, paint, plating, or a combination of wastes. Each disposal unit has its own peculiar problems. In cost analysis the handling of sludge is important; some plants can use sanitary sewers. Others must incinerate, dewater and dump, dewater and incinerate, or use biological reduction. The quantity and type of sludge and community requirements are determining factors. Citizen response is important. When a major problem of pollution is corrected, several smaller problems may become noticeable, if the community has become pollution conscious. The only available figures on disposal operating costs for GM are at Buick which has the most completely integrated facility in GM for the manufacture of cars. A mixed waste of soluble oil, insoluble oil, alkalies, paint, thinners, chrome, cyanide, power house blow down, and washer dumps is treated. These wastes, because of variations in concentration, must be treated in batches. The chemical costs for a six-month period are given in a table. The chemicals are alum, ferrous sulfate, lime, Jaguar (a coagulant aid used in processing), Separan (a coagulant used in treating sludges to bring the solids content to a level that can be concentrated on vacuum filters), and sulfuric acid. The sludge is concentrated, and the solids vacuum filtered and dumped into trucks and hauled to dumps for disposal. A breakdown of costs per month is given. The sludge costs per 1,000 gal of raw waste processed were: labor-waste plant $0.06 per 1,000, labor-others $0.27 per 1,000, and materials $0.09 per 1,000 or a total of $0.18 per 1,000. If disposal sites become scarce other means of final disposal must be found and there is now some study of this. Oil salvage helps to offset costs in the total cost picture. A recovery value of $77,211 for a six-month period is shown. The total treatment costs are given in a table and come to between $2.06 and $2.17 per 1,000 gal. Depreciation and insurance account for $986 of this. Costs may be lowered by a strong program of preventive maintenance, by automation, by segregating wastes, and by other methods. Automation is not a great factor at Buick for the operation is scattered over great distances and a mixed waste with a single operating unit is the most economical.

**64-0629**
Burkank, N. C., et al. Isolation and identification of anaerobic and facultative bacteria present in the digestion process. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.552-577.

Two main groups of bacteria have been reported in sewage sludge: the saprophytic acid formers; and the methane formers. The saprophytic bacteria are naturally abundant in sewage, reproduce rapidly in the digestion process, and produce the volatile acids which can occur in large quantities in anaerobic digestors. The methane formers use the end products of the acid forming bacteria. These two groups live in symbiosis in the same environment. Methane bacteria ferment only very select substrates, do not ferment carbohydrates and amino acids as do the common saprophytic bacteria, and their population in sewage is small.

Methane gas is one of the end products produced by them. The present study had five facets: (1) to improve and simplify the equipment used to cultivate these bacteria; (2) to improve identification techniques; (3) to isolate and identify those bacteria present in the most numbers in a laboratory digestor fed sewage sludge; (4) to correlate this population with the biochemical reactions in the digestion process; and (5) to isolate and identify the bacteria in the treatment plant of a meat packing plant. The diagram of a laboratory digestor is given. Photographs of a laboratory anaerobic sludge digestor and an inert atmosphere chamber are given. A simplified anaerobic culture tube was developed and is described in detail. The direct count procedure was found to be effective in showing significant variations in the population of a sewage sludge digestor. At efficient rates of digestion the predominant species were Cl. carnofoetidum and Bacillus knefelkampi in population ratios of one to seven, respectively.

**64-0630**

Butler, J. A case history and evaluation of waste treatment problems at the D. M. Bare Paper Company. Tappi, 47(11):82A, 85A, 92A, Nov. 1964.

A survey of waste treatment problems encountered by a papermill is reviewed with respect to stream and ground water pollution. Full waste treatment by the industry is now compulsory. Using the soda process, a 70 ft diameter clarifier providing a 3-hr settling period removed most suspended solids and 25 percent of the BOD from a flow of 1.7 mgd with 7,000 lb per day suspended solids and 1,000 lb per day BOD. A sludge lagoon received settled sludge. Converting to the bleached kraft process rendered this treatment inadequate. Study showed that with adjustment of pH to 6 to 8, and the addition of nutrients, a secondary process with activated sludge could remove 90 percent of the BOD from the wastes. The basic layout for a new system included two parallel aeration tanks and two 65 ft diameter final clarifiers. The aerators are hydraulically designed for two opposing flow patterns providing for conventional activated sludge, sludge reaeration, and step aeration processes. A treated effluent with less than 100 ppm suspended solids can be produced. Interfering substances are soap content in lagoon waste, titanium filler, or chlorine dioxide. Some changes for the operation are suggested to overcome these interferences.

**64-0631**

Buxton, D. H. Model tests of a slurry channel for fly ash disposal. British Hydromechanics Research Association, Oct. 1964. 17 p.

Experiments with a model of the proposed West Burton-Peterborough fly ash disposal channel are described. The investigation aimed at proving the design of a slurry channel and accessories intended to keep the concentrated slurry that is discharged into the channel on the move with no appreciable deposit of the slurry on the channel bottom. Preliminary studies were made using clean water as the working fluid. Dust was added to the water to form a slurry of 40 percent concentration by weight. The final design of an ejector, found from water tests, was then tested with the slurry. Any tendency of the ash to settle was determined by sounding the whole length of the channel bottom. Tests indicated that a workable system can be designed to handle a slurry of up to 50 percent concentration, provided that the agitator jets are distributed along the channel to give a general swirl, and have sufficient velocity to cut through deposits of ash on the bottom of the channel. A final test was performed with agitators positioned along the center line of the channel and arranged so that the discharge was directed along the floor in a downstream direction. Three agitators with 3/8-in. diameter orifices were spaced equally between each pair of ejectors and each agitator discharged approximately 5 gpm of slurry. The concentration of the slurry was 30 percent by weight. It was effective in keeping the slurry in suspension and the floor of the channel was reasonably clear of slurry mounds.

**64-0632**

Buzzell J. C., et al. Biological treatment of protein water from manufacture of potato starch. Part 1. Water and Sewage Works, 111(11):R306-R309, Nov. 1964.

The purpose of the study was to investiagate the biological treatment of protein water derived from the manufacture of potato starch, since untreated protein water has been the source of a variety of problems when discharged into streams. Relevant literature pertaining to waste analysis, recovery processes, and treatment methods was reviewed with the conclusion that little information is available about methods of diminishing the pollution resulting from the manufacture of potato starch. The origin and characteristics of potato starch wastes are discussed with a table giving the wastes from analysis of a typical continuous process starch factory. During the initial study phase, protein water from an operating starch plant was used. However, it became necessary to duplicate a starch plant, on a laboratory scale, in order to continue the supply of protein water. The synthetic waste had essentially the same characteristics as the plant protein water except for BOD where the high value of the plant waste was not reached by the synthetic waste. The biological treatment methods employed were activated sludge, using a five compartmented plastic rectangular box, and trickling filters, including both standard and high rate filtration. These methods, and the process of their operation, are described. Protein water analysis includes BOD, alkalinity, acidity, pH, total nitrogen, phosphorus, and turbidity.

**64-0633**
Buzzell, J. C., et al. Biological treatment of protein water from manufacture of potato starch. Part 2. Water and Sewage Works, 111(11):R310-R315, Nov. 1964.

The experimental results and discussion of a study on two biological treatment methods of protein water from the manufacture of potato starch are presented. Studies were conducted on activated sludge, carried out in five parallel compartments, and on trickling filters, involving both standard and high rate filtration. Results presented for activated sludge included operating data, loading intensity, BOD removal, and effluent characteristics. The greatest source of difficulty was the lack of control adequate to maintain a constant loading intensity. Results presented for the trickling filters include the effluent characteristics and BOD removal for standard and for high rate biological filtration. The relationship between hydraulic and organic loading rates is given. It was found that the activated sludge treatment gave BOD removals of about 95 percent at loading intensities up to 80 lb of BOD per 1,000 lb of mixed liquor suspended solids per hour of aeration. Standard rate trickling filters gave BOD removal of 90 percent or better with organic loadings up to 1,300 lb of BOD per acre ft per d BOD removals of 90 percent or better were obtained on high rate filters with loading up to 3,000 lb. A higher organic loading limit for high rate filtration might be obtained with a larger size stone than that used in this study. It was concluded that protein water from the manufacture of potato starch was successfully treated by standard biological treatment processes.

**64-0634**
Byrd, J. F., and J. H. Walter. Joint municipal-industrial treatment of combined wastes. Chemical Engineering Progress, 60(1):44-48, Jan. 1964.

The advnatages and prlblems involved in treating industrial wastes with domestic sewage in municipal treatment plants are becoming more generally recognized as this practice grows. The advantages are: savings to the municipality and to the industry in initial costs and operating costs, the opportunity to employ specialized personnel, less space required, and the improvement of the susceptibility of industrial waste to biological decomposition by the presence of domestic sewage. Two major problems arise under this method. Some materials should be excluded entirely from such a system. A lower limit is necessary on the pH of substances entering the sewers and a restriction on fats, oils, or greases. Whether sewage charges should be based on volume or property tax is another pertinent problem.

**64-0635**
Caron, A. L., and W. L. Carpenter. Effects of polyelectrolytes on primary deinking and boardmill sludge and on effluent clarification of deinking effluent. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.139-145.

The vacuum filter leaf test, laboratory sized sludge thickeners, and a pilot flotation cell were used to evaluate the effects of polyelectrolytes as conditioning agents from primary papermill sludges. Polyelectrolytes as flocculents to aid primary sedimentation were also evaluated on a mixture of de-inking washer waste water and white water. The vacuum filter test leaf was evaluated at several dry and form cycles, but the data reported are from a 30 second form time and a 30 second dry time which gave the highest hourly loading rates. All filtrations were made at a 15-in. mercury vacuum. The studies indicate that polyelectrolytes would be useful as conditioning agents for sludges difficult to thicken and de-water. In the case of effluent from the de-inking process mixed with white water, suspended solids concentration effluent was vital and the most significant gain was in increased settleability. Evaluation on the site is important since dosage was dependent on sludge type and composition and clarification of de-inking effluent was dependent on strength. Sludge thickening rates can be increased 55 percent at a dosage of 0.06 percent dry solids basis in the case of boardmill clarifier overflow and about 14 percent at 0.12 percent dry solids dosage for de-inking primary sludge. A supernatant was obtained with increased clarity over gravity thickening. Final concentration of the thickened sludge did not seem to be improved over gravity thickening, however. Flotation thickening increased solids concentration of the final product less than 10 percent. The polymers tested are not applicable to flotation thickening of these sludges. Vacuum filtration of both de-inking and primary boardmill sludge conditioned with polyelectrolytes increased the loading rate and the drainage rates by more than 150 percent. While the use of polyelectrolytes on a mixture of de-inking washer water and white water did not increase suspended solids removal it did result in a 40 percent increase in settleability.

**64-0636**

Centrifuge reduces sludge disposal costs. Public Works, 95(7):133, July 1964.

A centrifuge to dewater digested sludge at the Westchester County, New York, sewage treatment plant has cut the number of barge trips to sea from seven to two or three per month. The plant uses a 40 x 60 in. Bird continuous solid Bowl centrifuge, equipped for the use of flocculating chemicals should a more completely clarified liquid be required. The centrifuge raises the solid contents of the digested sludge from 2.9 percent to not less than 10 percent, a consistency that will permit maximum tonnage of solids per load, and at the same time be fluid enough for efficient sluicing from the barge. Provision is made for bypassing the centrifuge with digested sludge should it be necessary to dilute a more concentrated centrifuged product to maintain the 10 percent consistency.

**64-0637**

Coerver, J. F. Anaerobic and aerobic ponds for packinghouse waste treatment in Louisiana. In Proceedings; 19th Industrial Waste Conference, Lafayette, Inc., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.200-209.

The operations of ponds for treating slaughterhouse wastes at Houma, Louisiana, and similarly-designed installations at Slidell and Gonzales have been studied. The installations consist of three ponds in series: an anaerobic pond, a transitional pond, and an aerobic pond. The ponds at Houma remove 98.1 percent of the BOD applied. Most of the BOD is removed in the anaerobic pond where 879 lb per acre per day have been removed. The pond is only 2 ft deep with an applied loading of 950 lb per acre. Equivalent BOD removal per acre-ft of volume in the anaerobic pond could be achieved with more depth. Consistently satisfactory results in the mature pond installations at Gonzales and at Slidell confirm this. Volume rather than surface area appears to be the critical feature in anaerobic ponds although most of those studied are shallow. The smaller the surface area the sooner the important crust is formed over the surface. Current design criteria for anaerobic ponds are: a minimum volume of 1 acre-ft for each 500 hogs slaughtered per week; long and narrow shape with length at least three times the width to facilitate cleaning with a dragline; 1 acre of water surface area for each 667 hogs slaughtered per week; one-third transitional pond surface and two-thirds aerobic pond surface; a liquid depth of 4 to 5 ft; and aerobic ponds with the least possible perimeter with inlets at the center. These ponds have given satisfactory results, are the least expensive treatment units to build and operate, are reliable, and are free from odors except during initial operation.

**64-0638**

Cooley, A. M., E. D. Wahl, and G. O. Fossum. Characteristics and amounts of potato wastes from various process streams. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.379-390.

The Red River Valley of North Dakota and Minnesota is flat with meandering streams flowing only during the spring runoff. Any discharge of industrial wastes into these streams immediately results in nuisance development. The area is usually third in potato production in the U.S. Nearly 3 million hundred weight were processed (dehydrated, frozen french fries, potato flour, starch) in 1962 to 1963. About one bushel in four is discarded as preparation waste in processing. Plant surveys were made and the characteristics of the wastes examined. Better production methods might decrease the wastes. Lye peeling, steam peeling, and abrasive peeling were studied, as well as the wastes from potato starch manufacture. The wastes are very different and their characteristics have a great effect on treating and stabilizing effluents. The dehydration process and the methods used in the manufacture of potato flakes, potato chips, and potato starch are outlined with special reference to disposal problems. The strengths of the waste streams from these plants are summarized in a table. The figures are based on 5-day BOD and the figure of 0.17 lb per population equivalent. Clarifiers with a 2 hr detention time caused a decrease in organic loading of more than 50 percent in the potato wastes from the chip plant and more than 60 percent for the flour process using steam peeling. Neither the flake plant nor the starch plant had treatment systems. The population equivalents for commercial sized plants per ton of raw potatoes indicate the magnitude of the problem when sewage disposal facilities of towns with populations of 2,000 to 40,000 are used for these effluents. A starch plant using 200 tons per day raw potatoes is equivalent to a town with a population of 70,600. Primary treatment in which solids are removed mechanically is effective in lowering the organic content in most of the streams of these processes.

**64-0639**

Copeland, G. G., and J. E. Hanway. Treating waste NSSC liquors in a fluidized-bed reactor. Paper Trade Journal, 147(41):40-41, Oct. 1963.

The fluidized-bed process in the treatment and disposal of NSSC waste liquor is described. Mill liquor of approximately 115,000 gal per day of 8 to 10 percent solid content is fed to a three-effect evaporator where it is reduced to 28,800 gal of 35 percent solid content. This is fed into the fluidized-bed reactor through an injector-type nozzle extending to within about 12 ft of bed surface when operating with a six foot deep bed. Steam is the driving fluid in the nozzle. A temperature of 850 F is maintained above the freeboard. The liquor feed then either falls into the bed or is deposited on rising entrained dust particles. These dust particles eventually become large enough to fall and remain on the bed or are carried out by exhaust gasses, separated in a cyclone collector, and recirculated to the bed by a screw conveyor. The effluent gasses from the cyclone are discharged into the atmosphere after scrubbing. The organic material on the bed is oxidized at 1325 F and fluidized by air introduced into the firebox. The pelletized product is discharged from the reactor to silo storage. The system has many practical aspects. The total cost of the plant was less than $500,000. Operating cost has been less than $3 per ton of pulp. Anticipated scaleing problems were minor, with a once a week boil-out proving to be sufficient. This process is used in a paper mill, but is useful to other industries.

**64-0640**

Copeland, G. G. Water reuse and black liquor oxidation by the Container-Copeland Process. In Proceedings; 19th Industrial Waste Conference Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.391-401.

The Container Corporation of America operates a sulfite mill at Carthage, Indiana, which produces corrugating medium for shipping containers by the neutral sulfite semi-chemical process. Capacity is 170 tons per day which is made from 130 tons per day of virgin pulp and 40 tons per day of waste paper from old corrugated containers. The plant was converted to neutral sulfite pulping of the local hardwoods in 1958. For 50 years the mill discharged effluent directly into the Big Blue River (which has a low summer flow of 20,000 gal per min), but for the last 25 years stream control regulations have been imposed in increments based on a reduction of a diminishing balance. Generation BOD of this mill in process waters is about 50,000 lbs per day. Stream control regulations have reached a point of 99 percent removal of BOD (really 100% in practice) although there is no economic and acceptable process for this. The Sveen Pedersen clarification process based on chemical flocculation of suspended solids and flotation separation of fibers from the water provides reusable water containing 0.3 lb of suspended fibers or solids per 1,000 gals. Chemical costs for recycled water are about 25 cents per ton of pulp. The Container-Copeland process is described and a schematic flowsheet given. The process involves evaporation of waste liquors in triple effect forced circulation evaporators from an incoming concentration of 9 to 10 percent solids to 35 percent solids. The thickened liquor is then injected into a specially designed fluidized bed reactor in which an oxidizing atmosphere using air is maintained for combustion of the organic content of the black liquor. The carbon-hydrogen content of these organics is burned to carbon dioxide and water, and vented to the atmosphere. The cooking chemicals are deposited in the fluid bed where they pelletize and form nuclei for continued pelletization. The temperature of the whole operation is 1300 F. The system is fed continuously and discharges pellets of inorganic salts continuously. The end product pellets consist of a mixture of sodium sulfate-sodium carbonate in the same ratio as the similar mixture used in the cooking liquor preparation. Pellet size is 10 to 48 mesh.

**64-0641**

Davis, H. W., J. A. Biehl, and R. M. Smith. Pollution control and waste treatment at an inland refinery. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.126-138.

The refinery at Robinson, Illinois, consists of crude distillation, vacuum distillation, fluid catalytic cracking, light ends, and alkylation units. The refinery has its own steam and electric generating plant, and the usual tank farm with fuels and gasoline blending facilities. The capacity is about 65,000 barrels per day (summer, 1964). Waste control includes slop oil recovery with two API separators (traps), tankage, and a rotational vacuum precoat filter. Wastes from all sources in the refinery are collected in an underground oily sewer system and discharged to the treatment plant by a 30 in. sewer. The layout of the plant sewer system and of the treatment plant are shown in figures. A table summarizes the composition of each of the major waste waters by the unit producing them. Oil disposal, water waste treatment, and recent refinements are described in detail with figures and photographs. The management of this refinery believes that the solutions are economical and that no major capital investment will be necessary soon.

**64-0642**

Deposition of industrial wastes. Wasser und Abwasser, 105(6):153-154, Feb. 1964.

The Institute for Industrial Water and Air Pollution Control conducts meetings in regular intervals to discuss all pressing questions in the fields of water and air pollution and solid waste. The last meeting held on October 16, 1963, dealt with the deposition of industrial wastes. Several papers were presented discussing legal aspects, hygiene, possible dangers to the groundwater, and economical questions. Almost all speakers stressed the opinion that the technical and financial problems involved in the dumping of waste on disposal sites can be effectively solved only by a close cooperation among municipalities. (Text-German)

**64-0643**

Dias, F. F., and J. V. Bhat. Microbial ecology of activated sludge. Applied Microbiology, 12(5):412-417, Sept. 1964.

The microbial ecology of activated sludge was investigated. Over 300 bacterial strains were isolated from seven samples by plating on sewage agar. Bacteria of the genera Zoogloea and Comamonas predominated. Many isolates (51%) showed sudanophilic inclusions of poly-B-hydroxy-butyric acid. Sudan is a stain, largely used to determine fats. Sodophilic material was accumulated on media containing starch in 34 percent of the isolates. Sodophilia is defined as the reaction shown by leukocytes under certain conditions when treated with iodine. A large number required vitamins and/or amino acids for growth. None of the isolates tested for their ability to cause changes in sterilized sewage produced an effluent comparable in quality to the activated sludge control, although the activated Zoogloea produced activated sludge-like flocs, therefore demonstrating its importance in the aerobic biological methods of waste water treatment. A study of 150 bacterial strains isolated from raw sewage revealed that they differed from the sludge isolates in several respects. Coliforms, which constitute nearly 25 percent of sewage isolates, were rarely encountered in sludge. It appears, in conclusion, that flora is responsible in the metabolism of soluble substrates, while protozoa have the ability to remove the particulate fraction, including the bacteria that come in with the sewage. Data summarizes all results of the study.

**64-0644**

Donaldson, E. C. Subsurface disposal of industrial wastes in the United States.

U.S. Bureau of Mines Information Circular No. 8212. [Washington], U.S. Department of the Interior, 1964. 33 p.

A study of subsurface waste disposal in the United States shows that in eight states a wide variety of industrial wastes are being injected into formations ranging in age from Precambrian to Recent. More than 30 wells ranging in depth from 300 to 12,000 ft are used for waste disposal into subsurface formations which include unconsolidated sand, sandstone, vugular limestone, and fractured gneiss. Surface equipment used in waste disposal, and drilling and completion methods for disposal wells are described in detail. Data secured by visits to industrial plants are discussed, and a summary of operating conditions is presented. It was generally concluded that each waste disposal problem must be evaluated separately. Selection of surface equipment for preinjection treatment of the waste is contingent on the type of formation available. A buffer zone of water compatible with the injected waste can be created within the formation by pumping a large volume (250,000 gal or more) of fresh water into the formation before injection of the waste is started. Careful design and the use of plastic well tubing, together with maintenance of either diesel oil or an inert gas in the annulus between the tubing and casing, are effective means for dealing with corrosive wastes. Sand incursion into the bottom of the well can be avoided by packing gravel in a reamed cavity at the bottom of the well. The use of a waste reservoir exposed to the atmosphere should be avoided.

**64-0645**

Dornbush, J. N., and J. R. Andersen. Lagooning of livestock wastes in South Dakota. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.317-325.

The animal waste load of the north-central region of the United States is equivalent to 500 million people. This waste load is concentrated in large production units. Field spreading may be more costly than the value of the wastes as fertilizer. Lagooning is the most popular method now because little labor is required, nuisance is immediately reduced, and water is not greatly polluted. Many criteria used have been those of lagooning of domestic wastes. These are not applicable to farm animal waste disposal with their high solids concentration. The present report is on two kinds of research: (1) a field study of lagoons now in operation in South Dakota; and (2) an investigation of the operation of a poultry lagoon in the field and in the laboratory, together with changes in operation which changed an odorous situation to a properly functioning unit. In the first study, about forty livestock manure lagoons were studied. Most were for hog and poultry wastes, operate anaerobically, and performed satisfactorily. Only indoor poultry lagoons constructed under slat floors have consistently proved unsuccessful. A physical feature or poor operation accounts for the other failures. The study of the poultry manure lagoon summarizes fresh chicken manure characteristics, reports the physical observation made from June through November and chemical analyses made from June through October, and operational changes made. Lagoons must maintain anaerobic action and should be loaded on a volatile solids basis just as other sludge digesters are. A loading rate of 5 to 10 lb volatile solids per 1,000 cu ft of lagoon volume is satisfactory where winter conditions result in storage for long periods. Mixing to disperse sludge deposits is necessary to avoid offensive odors. An adequate water depth to make mixing easier is desirable. Depths of 5 to 8 ft should be considered.

**64-0646**

Dougherty, M. H. Activated sludge treatment of citrus waste. Journal of the Water Pollution Control Federation, 36(1):72-79, Jan. 1964.

The treatment of wastewaters is a problem of the citrus processing industry. Studies at the University of Florida indicate the activated sludge process to be the method of choice for treating citrus wastewaters. In these studies, the raw waste was prepared by diluting the juice with tap water to the desired solids concentration. The nutrient supplements were dissolved in the waste, and a sample was taken for immediate analysis. During processing, samples of the untreated waste, aeration liquor, treated waste, and excess sludge were taken daily. COD, and total and organic solids analyses on the treated and untreated waste, and total solids analyses on the excess sludge were run 5 days per week. The pH of the treated waste, aeration liquor, and untreated waste, and the percent sludge by volume in the aeration liquor and treated waste were determined 7 days per week. Excellent treatment was accomplished with the system. The treated waste contained less than 2 percent of the BOD of the untreated waste. Inorganic nitrogen and phosphate nutrients helped to treat the waste. If sludge was removed too rapidly, the degree of treatment was reduced. More than 20 percent of the total solids were recovered as dry excess sludge. Data and tables support conclusions given in this paper.

**64-0647**

Draper, R. E., and F. C. Mercier. Hydraulic barker effluent clarifier at Wood Products Division, Weyerhaeuser Company, Everett, Washington. In Proceedings; Eleventh Pacific Northwest Industrial Waste Conference, Corvallis, Oreg., 1963. p.168-171.

A system is described for recovering the bark from water used in barking operations at sawmills and purifying the effluent from the mills to safe standards for river disposal. Two screening operations and a Dorr-Oliver clarifier are used to reduce suspended combustible solids to 20 ppm in waste water, lower than commission control requirements. The larger bark particles are used as fuel for the mill's power plant.

**64-0648**

Dreier, D. E., and J. D. Walker. Grease incineration. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.161-166.

Grease in sewage comes from many sources: kitchen fats; soaps; garbage fed through household grinders; and industrial sources such as packinghouses and garages. Grease and oil accumulations interfere with anaerobic digestors, and the problem of disposal has led to a study of incineration. Greasy skimmings contain three overlapping components: fibrous trash; the grease itself; and ash. Preparation for incineration consists of first pumping the decanted grease from the accumulating tanks through a grinder which reduces the size of the trash particles to a size that can be handled by a metering pump. A hammer-mill type with ¼-in. slots is satisfactory. The grease then flows into a day tank and is further decanted. A small amount of heat speeds this. After decanting, a powerful propeller mixer-blender churns the contents of the tank to a uniform consistency after which the mixture is ready to be fed into the incinerator by any good positive displacement pump. The incineration must take place at above 2000 F since mercaptans are destroyed at 1,850 F and the hydrocarbons produced at lower temperatures are resistant to oxidation up through 1800 F. Air pollution and odors are thus avoided. To handle the unavoidable small water pockets the furnace must have an area of heated refractory and intensely burning material. The incinerator must be easy to operate and simple to maintain. The Circular Hearth Type Greaseburn unit with a forced draft continuously and completely incinerates decanted grease and other skimmings without using auxiliary fuel and discharges the combustion gases (before dilution at the stack) at temperatures from 2000 F to 2500 F. The design is illustrated in a schematic drawing, and the performance of the unit described. The unit is available in several sizes with capacities from 300 to 1200 lb per hr of wet grease.

**64-0649**

Drew, E. A. Sewage treatment and trade effluent control. Royal Society of Health Journal, 84(3):159-162, May-June 1964.

The two stages in effluent treatment are carbonaceous and nitrogenous oxidation. Raw sludge settling in the sedimentation tank is decomposed anaerobically in the digestion tanks. Organic matter is broken into simpler organic acids which are broken down to methane and carbon dioxide. Effluent strength can be reduced by the following means: decrease of effluent strength by slaughterhouse blood drip trays; screening frozen vegetable preparation water; evaporating or filtrating distillation wastes; salvaging cereal; and pretreating farm wastes. The adverse effects of toxic elements can be reduced if they flow at a steady rate. The majority of metals are brought out of solution and precipitated in the sedimentation tanks and pass to the digestors, thereby minimizing the quantity to be handled in the secondary biological treatment. Nitrobacter and Nitrosomonas are responsible for converting ammonia to nitrate. Dichlorphenol has been found to inhibit sludge digestion in a concentration of 20 ppm, while 25 ppm had no effect. There is an increased risk of sewer blockages due to conveying grease, rubber, and plastic wastes. Screens, macerators, comminutors, grit channels, etc., lead to deposition of material. Rate of sludge drying depends on sludge nature.

**64-0650**
Drying and compressing sewage sludge.
Compost Science, 4(4):32, Winter 1964.

A mechanical treatment for sewage sludge dehydrates fresh and rotting sludge by means of centrifugal power, and compresses the sludge to about 77 percent. The sludge will be changed into a paste form. It is compacted without chemical additions so as to be suitable for use in agriculture and industry. The centrifuge works automatically with a low energy requirement, and can be installed on about one or two sq m area.

**64-0651**
Ettelt, G. A. Activated sludge thickening by dissolved air flotation. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.210-244.

Sludge thickening became an urgent research problem at the Chicago Southwest plant when the Zimmerman Wet Oxidation (Zimpro) Process was considered as a method for final disposal of activated sludge. In order to maintain this combustion process on an energy basis, the sludge must contain a minimum COD of 30 g per liter. A COD of 60 g per liter would enable the process to be self-sustaining. This represents an activated sludge solids concentration of 3 and 5 percent respectively. Thickening by settling produces concentrations of 1.2 to 2.5 percent, although if 50 percent by weight of preliminary sludge is used, 5 percent solids is possible, but the activated sludge handling capacity is markedly decreased. Mechanical flotation is described, but the gain in solids thickening over settling is not significant. Dissolved air flotation is based on the small bubble diameter resulting from air released from solution. Air is added to a solid suspension and the mixture elevated to a high pressure. Since the solubility of air increases with pressure, the air dissolves. The pressurized suspension is then released into a chamber at a reduced pressure where air in excess of the decreased solubility forms the tiny bubbles. Formulas are developed, and the theoretical aspects of flotation discussed. Experiments were carried out and the results showed that activated sludge was thickened to a higher solids concentration by flotation (4%) than by settling (2%) in a full-scale unit. Maximum floated solids production of 12 tons per day and 55 percent solids recovery was obtained at a loading of 22 ton per day (13.5 lb per sq ft per day). The addition of 20 lb Purifloc 601 (Dow Chemical) per ton solids doubled the floated tonnage and increased total solids recovery to 99.6 percent for the loading of 26 ton per day. Inlet design was the most critical structural feature for flotation in order to provide minimal turbulence. The tray modified expansion well produced the best results. The total area used by the three inlets was less than 50 percent of the flotation unit area. Higher air to solid ratios at constant overflow rate improved performance.

**64-0652**
Evanson, A. E. Power or pollution--the use of lumber industry waste for electric power generation. Seattle, Cornell, Howland, Hayes, & Merryfield, 1964. 7 p.

The use of lumber industry waste for the generation of electric power is suggested as one possible solution for eliminating the air pollution problem from this source. The major advantage of the proposal is that it can be immediately applied without further development of methods or of special processing equipment. Arguments are set forth to show that the burning of wood waste for power is economical, since it can produce useful amounts of power at a cost less than that of any other fossil fuel. While such a use is economic within the framework of the regional and national economy, it is not at present economical for the individual lumber producer, unless some adjustments to procedures for purchasing the power generated and for taxing the investment are made.

**64-0653**
Fisk, W. W. Food processing waste disposal. Water and Sewage Works, 111(9):417-420, Sept. 1964.

Two distinct methods of waste removal employed by two baby food plants within the Gerber organization are described. At the first plant, facilities for waste start with tapered gutters spaced uniformly throughout the whole operation from preparation through labeling. Water is introduced at the shallow high end of each feeder gutter so that waste can be transferred from all plant areas to a main gutter which is tapered from each end to 3 drains. Waste is dropped from these drains to a grinder and then to a screening plant for separation of liquids and solids. The solid particles are transferred to hoppers for animal feed, and the liquid is piped to a nearby river. The plant is geared to take 2½ mil gal of waste water daily. An important feature is that the continuous transfer of waste is accomplished entirely by gravity, so that maintenance for the system is very low. The second plant involves a very different principle, since it is much larger, and there are no natural water resources for handling the large quantity of waste. A full scale operation of spray irrigation of all plant waste water is used. Waste water is separated from solids on a shaker screen, and the solids are disposed of as animal feed. The irrigation farm is composed of 140 acres with 17,000 ft of 10-in. asbestos-cement pipe laid 40 in. underground between the plant and the farm. A permanent irrigation installation is laid out with main lines and laterals, permitting alternate spraying of various sections. The sprinklers are capable of delivering 81 gal per minute over a 210 ft diameter area. Crab grass is used mainly as the cover crop, and every 2 or 3 years subsoiling 2½ ft into the ground over the entire irrigated area is necessary to prevent the formation of a heavy crust. Tests have shown that continuous irrigation has not caused any measurable effect on groundwater level or quality. It was concluded that both methods of waste disposal have proven most effective at each respective plant.

**64-0654**

Fossum, G. O., A. M. Cooley, and E. D. Wahl. Stabilization ponds receiving potato wastes with domestic sewage. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.96-111.

The operating characteristics of two lagoons in northern North Dakota, severely overloaded with industrial wastes, have been studied for 40 months. One of the lagoons serves Park River, population less than 2,000, with a primary lagoon of 25 acres and a secondary lagoon of about 10 acres, in operation since 1955. A flake plant using the lye-peeling process located in Park River uses well water with a total solids contents of about 5,000 ppm. Graton, population under 6,000, has two lagoons 70 acres in area with the influent piping so arranged that they can be operated in series or in parallel. A flake plant using the steam-peeling process, and a starch plant are located there. The lagoons have been in operation since 1957. The study began in January, 1961, when all three of the processing plants were discharging their wastes to the lagoons after first running them through primary sedimentation basins. The sludge settled was disposed of, and the liquid effluent sent to the lagoons which were known to be receiving a heavy organic loading with resulting odor problems in the summer of 1960. The lagoons were studied for volatile, fixed, and total solids, BOD, pH, alkalinity, and (when aerobic) for dissolved oxygen and COD. The results of these studies are presented in tables for each of the lagoons. It was found that potato wastes combined with domestic sewage are digested readily even when the organic loading from the processing plants was more than 15 times the organic loading from domestic sewage. While this digestion can take place either anaerobically or aerobically, the former leads to objectionable odors and other nuisances. Even with high pH wastes, carbonate alkalinity was found only during the time photosynthesis occurs. During the summer, potato processing wastes plus domestic sewage can be applied at well over the usual figure of 20 lb of BOD per acre per day for northern climates. (It may be that in September and October the amounts could be 50 to 60 lb of BOD per day.) Aerobic lagoons like these will remain aerobic until the BOD concentration reaches 200 or more ppm, but do not again become aerobic until the BOD falls below 100. Potato organics adversely affect surface reaeration by damping out wave action particularly during anaerobic conditions. During periods of heavy ice cover organic solids do not settle in appreciable amounts. During the winter months these lagoons are merely storage ponds. The accumulated load must be stabilized during the short summer.

**64-0655**

Garrison, W. E., J. D. Parkhurst, and C. A. Nagel. Gas recirculation--natural, artificial. Water Works and Wastes Engineering, 1(2):58-63, Feb. 1964.

The high cost of sludge handling facilities demonstrates the necessity of achieving dependable accelerated digestion. To accomplish this high-rate digestion, (a loading in excess of 0.15 lb of volatile solids per day per cu ft of digestion tank capacity) Los Angeles employs two types of gas recirculating digestors. The first is a natural recirculating type which depends on the percolating of the gas produced during digestion to accomplish the mixing of the sludge. The other type uses artificial circulating means such as impeller units, gas mixers, or external mixing pumps. These two types of digesters produce digested sludge which meets the accepted requirements of less than 400 ppm of volatile acids, low odor level, good drainability, and neutral pH. To obtain the preceding results consistently, five factors should be considered in the design and operation of sludge digestors. Mixing and gas circulation should be thorough enough to bring raw sludge into intimate contact with the digesting mass. Grit deposits should be minimized to maintain maximum active volume in the digestor. Also uniform temperatures (90 F to 95 F) and loading rates (in this case 65 to 75 thousand gpd) need to be maintained along with the elimination of any toxic wastes before they can enter the digestors. Included in the article are sample charts of the criteria used as daily checks on the efficiency of the digestors.

**64-0656**

Gaudy, A. F., and M. Ramanathan. A colorimetric method for determining chemical oxygen demand. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.915-926.

Using a variety of waste waters (including raw sewage from Stillwater, Oklahoma, primary effluent from Stillwater, refinery waste, and primary effluent from Oklahoma City) a thorough study has been made of COD determinations by the standard titrimetric procedure as compared with colorimetry. The results, presented in seven figures and one table, indicate that the two procedures yield comparable COD values. When the turbidity of the refluxed sample is low, the correlation between the two methods is very good. If addition of the catalyst at the beginning of the reflux period leads to precipitation of silver chloride, an alternate procedure wherein the sample is refluxed in the absence of silver sulfate followed by refluxing in its presence avoids the formation of a precipitate when high chloride concentrations are present. This study did not include using a shortened reflux period or altering the normalities, etc., recommended in Standard Methods, although these alterations may be applicable to many local situations. The only purpose of the study was to determine if colorimetry was a reliable replacement for the titration procedure. It is concluded that the colorimetric test provides a reliable and quantitative procedure which yields results comparable to those of the standard titration technique. The fact that it requires less technical skill and is quick may encourage more laboratory control in sewage treatment plants.

**64-0657**

Gaudy, A. F., and R. G. Turner. Effect of air-flow rate on response of activated sludge to quantitative shock loading. Journal of the Water Pollution Control Federation, 36(6):767-788, June 1964.

The effects of air supply during short term quantitative shock loading on the biochemical efficiency (as measured by the rate of substrate removal) of an activated sludge are given. The aeration rate was varied in an experimental activated sludge to which concentrated organic substrate was added to give shock loading. Dissolved oxygen and total solids tests were run on the sludge before and after the addition of the organic substrate. Warburg studies were made on the original and mixed sludge with COD and solids being measured hourly. The oxygen uptake on the Warburg respirometer was recorded throughout the experiment. The values of oxygen tension which affect metabolic rate lie below 0.5 mg per liter of dissolved oxygen. The increase in metabolic activity with increasing air flow rate was not very great. The short term absence of dissolved oxygen will not seriously affect the substrate removal of the process.

**64-0658**

Gaudy, A. F., et al. Symposium on joint vs. separate treatment of municipal and industrial wastes. Journal of the water Pollution Control Federation, 36(3):345-361, Mar. 1964.

Legal, technical, operational, and economic aspects are discussed. A fair distribution of treatment costs should be determined. Most municipalities have authority to tax property directly to pay for public services. The contract should describe type and quantity of waste, facility ownership, and leasing provisions. A single combined treatment plant costs less. Admixture of the city's domestic wastes would reduce the company's nutrient requirements. The charge for disposal services could be related to volume, BOD, COD, solids, or peak discharge rates. Highly septic sewage can cause odor. If industry decides to abandon an operation which has received expensive facilities at municipal cost, the city will not have more jobs and will lose money. To control effluents, we must control influents. Controlling wastes at the source will affect manufacturing operations: improved process efficiency; increased corrosion; slime and heat exchange surface; production schedule change; raw materials change; and location change. Recirculation is an example of containment and diversion to control wastes at source. Waste treatment is not always the most effective and economic way to reduce industrial pollution. Most industries are not located adjacent to a municipal wastewater treatment plant. When facilities have been developed without regard to the needs of industry, the city is usually reluctant to assume any responsibility for industrial wastewaters. The volume of waste can influence the size of sewers, pumping equipment, and settling tank volumes. Where the industrial load does not exceed 10 percent on a volume or pollutional basis, operation is financed through general 'ad valorem' taxes.

**64-0659**

Genetelli, E. J., and H. Heukelekian. Components of the sludge loading ratio and their effect on the bulking of activated sludge. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.456-466.

The type of organic material present in the substrate greatly affects the bulking phenomena, loading, expressed in lb of BOD per 1,000 cu ft of aeration tank volume, is related to the quantity of material in the substrate and BOD removal efficiency. Factors not taken into account in tank volumes are the amount of solids under aeration and the length of the aeration period. Parameters concerning the activated sludge process are reviewed from the literature. Three continuous-flow laboratory scale units were set up. The substrate used was casein hydrolysate, and the sludge loading ratio was 0.5 lb BOD per lb MLVSS. The results are summarized in tables. The percent sludge yield and the average BOD removal did not vary significantly. The results of variations of detention time and solids concentration are shown in tables. When detention time was constant, and solids concentration and BOD were varied, the sludge yields were constant. Keeping the applied BOD constant, increasing solids concentration and decreasing detention time increased sludge yields. The relatively low BOD removal was attributed to the substrate used. In Series I, the sludge bulked faster as the solids concentration and applied BOD increased. In Series II, bulking was faster with higher solids concentration and lower detention time. The sludge bulked faster in Series III as detention times increased and applied BOD increased. It was concluded that even at the same sludge loading ratio, variations in detention time, solids concentration, and applied BOD cause different responses by activated sludge. Sludge yields at a constant loading ratio are a function strictly of detention time. A constant sludge loading ratio results in constant BOD removal. The speed with which a sludge bulks is a function of solids concentration in the aeration tank. The dominant visible organism present in all sludges was Sphaerotilus, and like BOD removal, is a function only of loading and/or chemical composition of the substrate.

**64-0660**

Gerster, J. A. Cost of purifying municipal waste waters by distillation. Public Health Service Publication No. 999-WP-6. Cincinnati, U.S. Department of Health, Education, and Welfare, 1963. 43 p.

Desk top studies of the cost of distillation of waste water are made with the types of equipment proposed for use with sea water. The estimates are based upon those for sea water, but are modified to conform with the differences in composition of sea water and waste water, and differences in the modes of operation for the two feeds. The smaller concentration of scalling materials in waste water should allow distillation to be carried out at a higher temperature than can be used with sea water. The smaller total contaminant concentration results in a smaller boiling-point elevation. Because of the need to dispose of the blowdown permanently, it is necessary to concentrate to a far greater extent than in the case of sea-water distillation. Three types of equipment: Multi-stage flash; multiple-effect; and recompression-flash;

appear economically promising. For all types of equipment the cost for the distillation step alone is somewhat less than for sea water, but inclusion of costs for feed pretreatment and ultimate disposal of blowdown bring the cost up to about that for sea water.

**64-0661**
Goodman, B. L. Processing thickened sludge with chemical conditioners. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.50-87.

A review is presented of the history, chemistry, and modern practice of sewage sludge conditioning for vacuum filtration with 72 references, five figures, and one table. The scope is the role of chemical conditioners in processing sewage sludges. Terms such as sludge, precipitation, coagulation, flocculation, and coagulant demand, are defined, and the history of chemical use in sewage treatment traced from the French in 1740 to the present. Specific chemicals are cited (sulfuric acid and lime, later ferrichloride) and the dose rates given from the literature. Modern concepts of sludge chemistry are described in detail; the inorganic chemical reactions which take place between coagulants and the bicarbonate alkalinity of sewage and between the coagulants themselves when more than one is used are given. For example, aluminum sulphate reacts with bicarbonate alkalinity to yield calcium sulfate, aluminum hydroxide, and carbon dioxide. Fundamental colloid forces are described and illustrated in a figure. The physical factors affecting chemical conditioning requirements are: point of conditioner application, mixing, detention time, filter aids, and type and condition of equipment. The development and control of a sludge conditioning program is discussed in terms of the most important variable: the coagulant dose rate. The Buchner funnel method and other methods for controlling the day-to-day operation of sludge conditioning are described in detail. Illustrations are given. Modern sludge conditioning practice is summarized.

**64-0662**
Greenberg, B., and A. A. Bornstein. Fly dispersion from a rural Mexican slaughterhouse. American Journal of Tropical Medicine and Hygiene, 13:881-886, 1964.

A recent study was made to determine the dispersion patterns of flies from a small Mexican slaughterhouse. This survey was undertaken because of the concern caused by the number of salmonellae these flies carry. Approximately 200,000 flies in and around the slaughterhouse were marked by spraying them with a 1 percent aqueous solution of uranin. During the next 6 days the flies were collected at six different sites which were from one-tenth to 3 miles from the plant. A total of 543 marked flies belonging to six species were recovered, the majority of them being the common housefly, Musca domestica. This group of flies yielded seven salmonellae and two shigellae. Five of the salmonellae were recovered from sites one and two, which were respectively 0.10 and 0.15 miles from the slaughterhouse. In conclusion, it was decided that this ready dispersion of salmonellae contaminated flies constituted a definite health hazard.

**64-0663**
Grieves, R. B., and D. Bhattacharyya. The foam separation process: a model for waste treatment applications. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.965-976.

A model has been developed to provide a quantitative description of the continuous foam separation process. Much of the development is analogous to solid-liquid adsorption, replacing the solid phase with a gas phase and including the important factor of entrainment. Considering the liquid-solution phase as a single equilibrium stage, relations have been derived and verified. The mathematical terms are defined in a nomenclature section. It is hoped that this approach may be applied to more complicated, multi-stage systems involving foam reflux, and feed into the foam phase. Although only pure surfactant-water systems have been treated, it is hoped that this basic approach may be applied to the industrial and domestic waste treatment and thus assist in the further utilization of the foam separation process.

**64-0664**
Guccione, E. Wet combustion of sewage sludge solves disposal problems. Chemical Engineering, 71(11):118-120, May 25, 1964.

Sewage sludge, an aqueous dispersion of organic matter, burns and gives energy like a fuel. The Sanitary District of Chicago's Southwest Works has a plant which disposes of the sludge load from two million people. The plant, consisting of four 50 ton per day 'Zimpro' units, lacks such 'normal' equipment as filters, sludge digestion units, incinerators, and other auxiliary equipment. Operating in a closed system with oxidation occurring in water, there is neither odor nor air pollution. In addition, maintenance, operation, and power costs are far below normal, the last ideally costing nothing due to self-generation. As included data demonstrates, the total $23.30 per ton expense is $14.70 less than the heat drying method, and the former figure will continue to decrease. In the process, sludge is continuously fed into aeration tanks where it is mixed with pressurized air. The air flowrate depends on the nature and type of organic waste. Wastes then flow into final settling separation tanks where the effluent sewage is discharged into the Chicago Sanitary and Ship Canal; the activated sludge is sent to be mixed with raw sludge to a 3 percent concentration. The sludge next enters the Zimmermann process where combustion occurs, in an aqueous phase, without heat dissipation. Hot gases and steam leave the reactor and are employed for power generation and heat recovery (measured at 80% chemical oxygen demand). The treated waste or ash, now mainly inorganic, leaves the system with excess water, free of pollutants and virtually odorless.

**64-0665**

Hammarstrom, E. C. Mechanical aspects of vacuum filtration. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.101-104.

Remarkable progress has been made in the last 15 years in the development of the continuous drum type filter specifically designed for sewage. Previously attempts were made to adapt an industrial type unit to sewage, but an industrial type filter is designed for a clear filtrate while a sewage plant is designed to dewater the maximum amount of suspended solids. Industrial filters may be rated at 1 to 4 lb per sq ft per hr and sewage filters at 5 to 8 lb per sq ft per hr. Industrial filters are usually a capital expenditure and their operation and maintenance an expense item. In a public agency, it is usually easier to get sufficient money to build a plant than to operate and maintain it. Before World War II, the principal types of filters were tight woven cloth fabrics. It has since been learned that an open mesh, such as was found with the coil spring filter media, or metal meshes and open synthetic fiber cloths would produce much better filtration particularly with the vacuum filtration units dewatering undigested sewage sludges. Some belt type filters have been used, but their value remains to be determined. Practical suggestions are made for maintenance and operation from the mechanical point of view.

**64-0666**

Hanson, A. M., and T. F. Flynn. Nitrogen compounds in sewage. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.32-44.

The organic constituents of normal urine include 25 gm per liter urea, the major organic constituent with lesser amounts of non-protein nitrogen in creatine, uric acid, and ammonia. The chemical constituents of feces are also listed. Stool nitrogen is less than 10 percent of urinary nitrogen and is excreted at an average rate of 1.3 gm per day. The major source of nitrogen in human wastes is urea, which, with ammonia, accounts for 85 percent of the nitrogen excreted. Three sewage plants in the Albany metropolitan area have been studied: the Colonie plant serves 3,400 people and a few industries, a bakery principally; the Delmar plant serves 9,000 people, with no known industrial wastes; and the Albany plant serves 130,000 with a few industrial plants. Although Rosenthal's colorimetric method for the determination of urea is sensitive enough, the recent variation of Ceriotti and Spandrio is recommended. The fresher the sewage, the greater the concentration of urea. Median values found were: Colonie, raw 18.3, final 3.0; Delmar, raw 9.6, final 3.5; and Albany raw 7.3, final 2.1 mg per liter. The sum of the ammonia and urea nitrogen as expressed as a percentage of total nitrogen (Kjeldahl nitrogen) was calculated from median values obtained during 6 to 8 months. These were: Colonie, raw, 79.1, final 76.1; Delmar, raw 81.2, final 82.7; and Albany, raw 80.9, final 85.5. The highest concentration of urea was found in Colonie sewage, with unexpectedly high residual concentrations in the effluent. This plant has secondary treatment, but is hydraulically overloaded. To determine the effect of secondary treatment on hydrolysis of urea, some samples were collected from a similar plant at Rotterdam which is not overloaded. Secondary treatment reduced urea concentrations to very low values. Methods for the determination of protein nitrogen were compared and the findings are discussed.

**64-0667**
Hart, S. A., and P. H. McGauhey. The management of wastes in the food producing and food processing industries. Food Technology, 18(4):30-36, Apr. 1964.

The management of wastes from the food producing and food processing industries is aggravated by the emphasis on the cheapness rather than the adequacy of the method. Problems, and possible approaches to a solution are explored. Five to 10 lb of solid waste are left in the field or processing factory, and many gallons of waste water are discharged for each pound of food produced for the household. Agriculture is by far the greatest producer of wastes. Three lb of manure are produced for each quart of milk, and 1.09 billion cu yd of manure are produced each year in the United States. Photographs of a corn field, a waste pile of tomatoes, cull fruit, and a tomato harvester in action illustrate the problem. A series of photographs of spray irrigation and ridge-and-furrow irrigation illustrate methods of disposal of cannery wastes. The incineration of cereal stubble and tree prunings only adds to the air pollution problem. From 1 quart to 4 gal of liquid waste are produced at the cannery for each pound of fruit or vegetable produced. There appears to be no simple solution to the problem, but the approach needs to be based on a program of education of the citizen, the politician, and the food producer. In addition, there must be a program of research into economical, technologically feasible methods of waste disposal with the funds coming from public sources, because the food industry appears unable to resolve the problem.

**64-0668**
Heinicke, D. New technological viewpoints in the treatment of waste water and waste material with special regard to the waste water of the chemical industry. DECHEMA Monographien, 52(895-911):31-51, 1964.

In the purification of industrial effluents and chemical processes for detoxication, flocculation for the precipitation of colloidal and fine suspended matter, and biological treatments for decomposing organic impurities in effluents have proved most effective. An account is given of effluents issuing from oil refineries, coke ovens, and pharmaceutical and chemical plants. The sludge produced in the process is either anaerobically treated and then used as fertilizer, or it is thickened, dehydrated, and burned. The sludges coming from domestic purification plants are mostly anaerobically decomposed but many of the sludges coming from industrial waste waters are not putrescible. The dehydration of sludges can be performed with centrifuges or with filters, vacuum rotating filters, or filter presses. The advantages and disadvantages of the various methods are briefly assessed. Additives such as flocculants or ash are mostly used in the filtering process. For the incineration of the dehydrated sludge rotating tube furnaces, story furnaces, and turbulent layer furnaces are used. The combined sludge/waste incineration had been realized for the first time in a South German municipality. In this case, the sludge is dehydrated in centrifuges and vacuum filters and passed to a seven-storied furnace. The waste is crushed in a hammermill and directly supplied to the combustion stage of the furnace. (Text-German)

**64-0669**
Hubbell, G. E. Theory and application of vacuum filtration. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.88-100.

Filtration is the process of separating solids from a liquid by passing the liquid through a porous medium on which the solids remain to form a cake. Vacuum filtration of conditioned sewage sludge takes place on a rotary type filter made of cloth, steel mesh, or steel coil springs. The filter medium is constantly passing through the sludge and, by means of a vacuum, picks up solids to form a cake which is then partially dewatered and discharged as a wet cake. The filtrate, less the solids deposited in the cake, is generally discharged back into the sewage plant influent. A series of 16 equations is developed to show the general theory of filtration from Poiseville (1842) up to the present. From the practical standpoint, the variables in the operation of a given sewage sludge filter as related to theory are: conditioning agents; vacuum; percent form time; drum revolutions; drum submergence; and filter media. The engineer often does not depend on these theoretical equations, but must depend upon the technical assistance of filtration equipment manufacturers. Perhaps the most important value obtained from a study of the theory of filtration is the development of the concept of the specific resistance of sludge as a means of evaluating laboratory tests of conditioning agents to assure maximum cake production at minimum cost.

**64-0670**
Imhoff, K., and K. R. Imhoff. Natural procedures for dewatering of digested sludge are still economical. Gas und Wasserfach, 105(26):710-715, June 26, 1964.

Examples are presented which illustrate a recent trend toward natural dewatering of digested sludge at important sewage treatment works in the United States, Canada, England, and Germany. The chief factor in a movement toward the use of drying beds, lagoons, and wet disposal for agricultural use has been the relative economy of these methods compared with processes such as vacuum filtration and heat drying of fresh sludge. Cost calculations and distance considerations are presented, and discussed with regard to conditions in Germany. The use of new sludge lifting machines--which might be expected to double the drying capacity of beds--is advocated for communities of over 30,000 inhabitants. (Text-German)

**64-0671**
Industrial waste and the local authority. Surveyor and Municipal Engineer, 123(3738):27, Jan. 25, 1964

As dumping space within economical trucking distance becomes scarce, municipal authorities become reluctant to accept refuse from private trucking firms handling industrial waste under contract. There is no statutory obligation in Britain to accept potentially hazardous waste from industrial waste disposal firms. The hazard to workers and trespassers from chemical wastes and highly flammable materials increases the cost of dump operation, and authorities regard the mixing of industrial and domestic refuse with justifiable suspicion. Transfer stations can provide for economy by permitting the use of larger trucks on longer hauls to distant private dumps. For mixed dumping of domestic and industrial refuse, the best plan is to fill the lower levels with industrial waste, and the top 6 to 8 ft should be filled with the domestic refuse which would more readily support growth.

**64-0672**
Industrial waste removal. Public Cleansing, 54(2):715, Feb. 1964.

The Powell Duffryn organization developed the Dempster system of industrial refuse collection and storage in England in 1960, and thereby instigated a containerization boom. Reasons why private enterprise can effect industrial services more advantageously than local authority are listed. Containerization solves the problem of storage and collection of industrial refuse in England.

**64-0673**
Jaag, O. The contribution of the industry for keeping the water and the air clean. DECHEMA Monographien, 52(895-911):1-29, 1964.

The three problems of waste water purification, air pollution, and solid waste removal are discussed. As far as the last subject is concerned, sanitary landfills are discussed and explained, but a growing shortage of disposal sites made it necessary to turn to other methods such as composting or incinerating. A brief review of the essential features of both methods is given. (Text-German)

**64-0674**
Jenkins, S. H., D. G. Keight, and A. Ewins. The solubility of heavy metal hydroxides in water, sewage, and sewage sludge. International Journal of Air and Water Pollution, 8(11/12):679-693, Dec. 1964.

Although heavy metals in solution are discharged into many sewage systems and salts of some of these metals are known to inhibit biological activity, the extent of such inhibition occurring under treatment plant conditions is uncertain. The soluble metal ion mainly causes interference with biological oxidation, and if precipitation of the metal occurs then inhibition severity is correspondingly reduced. Experiments were performed to determine the precipitation of certain heavy metals by sewage, and the effect of such factors as metal concentrations and pH upon precipitation. Domestic sewage, sampled when the sewage was at its minimum as well as its maximum strength, precipitates soluble copper salts. The extent of precipitation occurs almost instantaneously. Percentage of copper precipitated increased with copper concentration utilized. With higher than neutral sewage pH's, a higher percentage of precipitation can be expected. Very acidic sewage would therefore inhibit precipitation. Similar results were generally obtained with soluble nickel salts, except total precipitation did not reach so high a level. A major difference was the ineffectiveness of lowering pH on nickel precipitation. Zinc behaved much more like copper than nickel. Precipitation of hexavalent chromium depends upon a long period of contact and neutral conditions. Included data point out all results of the study.

**64-0675**
Jenkins, S. H., and J. S. Cooper. The solubility of heavy metal hydroxides in water, sewage, and sewage sludge. International Journal of Air and Water Pollution, 8(11/12):695-703, Dec. 1964.

Heavy metals in industrial waste water which is discharged into a sewerage system become concentrated in the sewage sludge as a result of precipitation. Since digestion of such sludge occurs in the presence of high concentrations of heavy metals, it was inferred that the metals must be present in an insoluble form. The actual solubility of the heavy metals in dried sludge containing a high concentration of metal was determined by percolating water through a column of dried sludge and analysing the filtrate. This showed that the concentration of copper never rose above 3 ppm. At the beginning of the percolation process and at the end, it fell to zero. Nickel was extracted more easily; the concentration reached 21 ppm, but eventually fell to below 1 ppm. Zinc was also dissolved, the concentration in the filtrate rising to a maximum of 42 ppm zinc, and then falling to zero. Iron was insoluble. If the proportions of sludge and soil were the same as those present when sewage sludge was used agriculturally, the water extracts contained, at the most, only traces of the metals. By percolating a series of buffered citric-acid-ammonium citrate solutions through the sludge at pH values ranging from pH 2 to pH 6, it was found that heavy metals were extracted more readily and concentrations in extracts of over 1000 ppm were obtained. While up to 50 percent of the calcium was extracted this way, only 5 percent of the sodium and potassium could be removed.

**64-0676**
Jones, P. H. The effect of temperature and oxygen tension on one of the microorganisms responsible for sludge bulking. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.902-914.

Evidence is presented that several filamentous microorganisms are perhaps more closely associated with the bulking phenomenon than Sphaerotilus, but because of similarities in morphology and because of a lack of information regarding the physiological responses of Sphaerotilus, many of these organisms have been incorrectly identified. The literature on the characteristics of Sphaerotilus and of Geotrichum is reviewed (20 references). Experimental procedures are described and the results reported in figures and tables. Geotrichum and Sphaerotilus are very similar and probably have been mistaken for each other in the past. Morphologically, Sphaerotilus is a filament of ensheathed cell showing occasional false branching while Geotrichum displays similar morphology by fragmentation of mycelium. The holdfast of Sphaerotilus is very similar to the arthrospore of Geotrichum after the germination of mycelium. Both organisms: (1) favor high carbohydrate nutrient sources; (2) tend to form long slimy sheep's tails when growing attached in such conditions; (3) grow cottony colonies on agar; (4) form coherent pellicles on broth cultures; (5) grow as small pellets on the bottom of a liquid culture; and (6) have characteristic sudanophilic refractile bodies. Microscopically the continuous protoplasm filled tubes of Geotrichum can look like empty Sphaerotilus sheathes. However, Sphaerotilus requires a complex organic medium for growth and Geotrichum will grow on chemically defined medium. Geotrichum's specific growth rate appears to be a great deal higher than that of Sphaerotilus. Geotrichum has a wider pH range than has Sphaerotilus. Geotrichum has an unusual specific growth rate versus temperature relationship, following a straight line arithmetic instead of a straight line logarithmic (exponential) pattern. It can grow satisfactorily at dissolved oxygen levels as low as 0.1 mg per liter.

**64-0677**

Katz, W. J., and A. Geinopolos. Dissolved air flotation as a method of thickening aerobic biological solids. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.17-36.

Dissolved-air flotation was first used in industry to remove suspended matter from paper wastes, laundry wastes, soap wastes, machine shop wastes before their discharge into a body of water or before re-use of the water and/or recovery of the suspended matter. Dissolved air flotation is being used not only as a method of solids separation for clarification purposes, but as a method for dewatering of aerobic biological solids in sewage treatment plants. Flotation is particularly useful in thickening activated sludge, which is most difficult to concentrate. A description of the dissolved-air flotation process is given. A flow diagram of the process is shown in a figure. This illustrates a specific flow pattern, covered by patents, but also illustrates the general principles involved in the method. The object of the process is to attach a fine air bubble to the suspended matter and cause the material to separate from the water in an upward direction. Other figures present the effect of the air-charged stream on the rate of rise, the solids concentration gradient in the floated sludge blanket, the apparent viscosity of activated sludge vs. time, the relationship between percentage of solids and viscosity of activated sludge, the effect of temperature on the viscosity of activated sludge, the effect of surface tension on bubble size, the effect of high molecular weight polyelectrolytes on the flotation thickening of activated sludge, and a comparison of gravity thickening and flotation thickening in mixtures of activated and primary sludges. The process performance has been analyzed by a study of the comparative effectiveness of thickening activated sludge by gravity and by dissolved-air flotation. The gravity unit was 70 x 46 x 14 ft. The flotation unit was 15 x 4 x 9 ft. The results are given in tabular form. Another study has been made of a flotation thickener at another plant. Performance data were obtained from Mar. 1959, through May 1961. The results of this study are reported.

**64-0678**

Kehrberger, G. J., et al. BOD progression in soluble substrates. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.953-964.

Temperature affects the rate of substrate utilization in two ways: first, on the rate of reaction of the organisms and the substrate; and secondly, on the diffusion of substrate to the organisms. The purpose of this paper is to present a model of a biological system based on the principles of transport phenomena which offers an explanation of the effect of temperature on the rate of substrate utilization. Although the concepts presented are based on studies of the microbial degradation of glucose, a soluble substrate, they are applicable to any growing microbial system. Seven figures and many formulas are presented. The conclusion is reached that the effect of temperature on the utilization of substrate in a quiescent BOD bottle is controlled by the change in the rate of diffusion of substrate to the bacterial cells with temperature. Mixing the BOD bottle during incubation makes the system more closely approximate the reaction limiting case.

**64-0679**

Kennedy, R. R. Thickening by elutriation and chemical coagulation. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.37-49.

Elutriation is defined as to purify by washing and straining or decanting. It is also a process of sludge conditioning in which certain constituents are removed by successive decantations with fresh water or plant effluent, thereby reducing the demand for conditioning chemicals. The disposal of solids from sewage during treatment has always been one of the problems of effective sewage disposal. The process of elutriation was developed and its use justified, because of the reduced amount of chemicals required for vacuum filtration of sludge. Iron salts, usually ferric chloride, have been used as the coagulating agent. If used in the quantity necessary to reduce the high alkalinity of the normal digested sludge, the cost may be high. Elutriation can reduce the alkalinity and thus the amount of coagulating chemical used by one-half to one-fourth. A figure illustrates the flow of a two-stage elutriation system in which the sludge proceeds from the primary digestion unit to the secondary digestion unit, thence into the first elutriation tank and on into the second elutriation tank in preparation for chemical conditioning and filtration. A modification of the cycle in which the sludge proceeds from the primary digestion tank through an elutriation basin into the secondary digestion tank (really a holding tank), and thence into elutriation before proceeding to chemical conditioning and filtration is also shown. The theory and the operation of this process are summarized. Elutriation is being used in the thickening and consolidation of raw sludges (the Torpay process). Part of the large quantity of water may be required to keep the settled sludge in an aerobic condition rather than for washing out undesirable elements. Results have been quite erratic, and data now being collected will indicate more fully the applicability of elutriation. Another use is interstage elutriation for the treatment of sludge between a primary digester and a secondary digester with the purpose of thickening rather than the reduction of alkalinity. This has proven to be effective. Buoyant gases are removed, the specific gravity of the sludge increased and a denser sludge produced. The theory and practice of chemical coagulants is discussed and findings are presented in a table.

**64-0680**

Kiess, F. Treatment of sewage sludge. In Proceedings; Second International Congress, International Research Group on Refusal Disposal, Essen, Germany, May 22-25, 1962.

The most important methods of sludge treatment and of sludge pretreatment for subsequent composting with garbage are surveyed. All artificial drainage methods endeavor to obtain drainage water from the sludge as free of solid residual materials as possible, or totally free of such materials, so that it may be returned without any further treatment to the purification plant. These methods include the use of vacuum filters, pressure filters, and filter presses. No dynamic procedure can be used as a single phase procedure for the drainage of normal sludges. A second stage must nearly always follow, as it is not possible to obtain a filtrate or a centrifuge overflow or a sieve passage free of solid materials after the first operation. Centrifuges, the Russel sieve, the Edco filter, the Heymann Sieve, and the Rhewum Sound Sieve are discussed. When the final product is to be not only a dispersible sludge with a 65 to 70 percent water content, but a strewable dry product, then the drainage stage must be followed by a drying process: hot air drying; joint sludge garbage composting; or Popel's press drying procedure. Combined procedures for the drainage, drying and disposal of sludge include: the Starcosa drainage procedure according to Opelt; the Wegmann-Gujer procedure with addition of ash; the Lurgi ash procedure; the Passavant sludge treatment method with the addition of ash; and the Fige method of the Ems Association. The combined ash procedures will probably be used more and more in large urban areas and in industrial areas, whereas smaller towns and rural areas will continue to use the drainage methods.

**64-0681**

Koenig, L. Ultimate disposal of advanced treatment waste. U.S. Department of Health, Education, and Welfare, May 1964. 141 p.

Cost estimates are made for ultimate disposal of the contaminants resulting from complete renovation of a municipal waste water. The processes investigated are injection to underground formations, placement in underground cavities, and spreading. Figures and references are included in each part. Part 1. Conditioning and injecting costs varied from \$0.13 to \$27 per 1,000 gal injected (7,000 ft, 260 psi wellhead pressure, 1.187 fluid density) as the capability decreased from 2 million to 1,000 gal per day. Injection is very much cheaper than wet oxidation, but may be limited by availability of injection sites. Part 2. For disposal of advanced-treatment wastes in cavities mined by conventional methods, fixed costs alone vary from \$243 to \$72 per day, respectively. Costs for disposal in cavities created by nuclear blasting are highly speculative.

Fixed costs vary from $139 to $0.269 per 1,000 gal per day. Disposal to cavities created by mineral mining is considered. Injection is preferable to placement in cavities where possible. Part 3. Spreading costs varied from $0.30 to $0.001 per 1,000 gal as the capability varied from 1,000 to 10 million gal per day. Land costs between $25 and $1,000 per acre had very little effect on over-all cost. The costs are 1 percent or less of those for any other disposal method because of potential ground water pollution.

**64-0682**

Komolrit, K., and A. F. Gaudy. Substrate interaction during shock loadings to biological treatment processes. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.796-810.

The heterogeneous populations used in these experiments were developed from sewage seed obtained at the municipal treatment plant in Stillwater, Oklahoma. Systems were started using dulcitol, sorbitol, ribose, and glycerol as sole carbon sources. Each day a small amount of the previous day's growth was transplanted into fresh medium. They were thus 'young' cells. For each experiment, cells were harvested from these units near the end of the log phase of growth, washed in 0.05 M phosphate buffer, pH 7, and resuspended in fresh medium containing the same carbon source on which they had been growing. Aeration was begun, and samples were withdrawn for measurements of substrate removal and biological solids production. After substrate removal was well under way, another carbon source was rapidly introduced. Thus each system received a qualitative shock load while it was rapidly metabolizing the carbon source to which it was acclimated. The biochemical response was examined by continuous sampling and analyses for specific carbon sources and total COD removal. A unit which did not receive the shock was a control. The results are described in detail and given in eight figures. Fructose inhibited sorbitol removal just as glucose has been reported to. Control systems for fructose and sorbitol are also shown. It is seen that fructose was eliminated at about the same rate in the control and in the combined system while sorbitol is greatly retarded in the combined system as compared to the control. In both control systems comparison of COD and specific substrate tests showed no release of intermediates during the metabolism of fructose or sorbital. It was therefore concluded that the subtraction technique was valid for this system, and that sorbitol removal was curtailed in the presence of fructose. The introduction of glucose caused an immediate disruption of dulcitol metabolism. The findings are discussed and a generalized metabolic flow chart for various carbohydrates and related sugar alcohols presented.

**64-0683**

Krebs, R. D., and J. H. Hunter. Evaluation of soils and use of soil surveys for engineering purposes in urban development. Washington, Federal Housing Administration, 1963. 71 p.

The widespread conversion of rural areas to urban and suburban developments in recent years has necessitated the use of single unit sewage disposal system depends upon the design of the system and the ability of the soil to absorb the effluent. In this report, soil is considered in detail together with the geologic, hydrologic, and topographic conditions that may exist at individual sites. Soil evaluation requires consideration of the position, profile, and performance of the soil. Rating soils for individual sewage disposal systems is difficult. The suitability of the soil may be rated as favorable, conditional, and unfavorable. Rating soils using pedological soil survey reports and maps is discussed. (Defense Documentation Center AD 435164)

**64-0684**

Kugelman, I. J., and P. L. McCarty. Cation toxicity and stimulation in anaerobic waste treatment. II. Daily feed studies. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.667-686.

Most of the studies on cation effects have been made on a slug basis in which a sudden addition of a cation or a cation combination is made to an active bacterial population. Although such a situation might occur, a more likely one is that high concentrations of a cation would always be present in the waste. The present study was made of a system to which cations were added daily with the waste substrate to a continuously operating treatment system. It was found that the phenomena and relationships observed in slug feed studies for cation effects are applicable to daily feed operation. Acclimation to the toxic effect of a cation will take place under daily feed operation and acclimation increases the tolerance level to the toxic effect of a cation two or three times. Acclimation and antagonism can take place at the same time. When this happens, cation toxicity is alleviated to a greater extent than by either process alone. Sodium produces a significant block in synthesis at concentrations below those at which it will affect the rate of acetate utilization. With a 15 day retention time, and an organic loading of 0.5 gm per liter acetate, the upper limit of cation concentration with no antagonists present is 0.3 M for sodium, 0.35 M for potassium, 0.15 M for calcium, and 0.0065 M for magnesium. Under the same conditions, but with antagonists present, the upper limit of cation concentration was not exceeded in the present study, but was greater than 0.35 M for sodium, 0.35 M for potassium, 0.20 M for calcium, and 0.14 M for magnesium.

**64-0685**

Kulsehov, P. Expedite the construction of chemical plants in Western Kazakhstan and utilize liquid wastes at the Zaprozh'ye Coke-Chemical Plant. In USSR industrial development. Soviet chemical industry. No. 65 (JPRS:18,851). Washington, U.S. Department of Commerce, Joint Publications Research Service, Apr. 1963. p.15-18.

Personnel of the Zaporazh'ye Coke-Chemical Plant devised a process to extract salts from spent sulfur-purification liquor which had previously been discarded together with liquid wastes into the phenol sewer-age. Studies performed on this extraction process led to design and construction of a semi-industrial installation which has produced 10 tons of salt. One component of the extracted salts--sodium thiocyanate is particularly valuable.

**64-0686**

Lamb, R. A suggested measure of toxicity due to metals in industrial effluents, sewage and river water. International Journal of Air and Water Pollution, 8(3-4):243-249, Mar.-Apr. 1964.

Colorimetric methods are used for detection and estimation of metals in sewage and effluents. Pyridyl azo-resorcinol (PAR) was used as a reagent since it produced a reddish brown color with iron, cobalt, nickel, copper, zinc, calcium, vanadium, lead, uranium, titanium, and the rare earth metals. It was decided to base the calibration on iron, a nontoxic metal. An upper pH limit of 4 is suggested to ensure that the metals are completely in solution before addition of PAR. Utilizing sampling results, it was decided to measure the optical density at a final pH of 9 and a wavelength of 500 mu. A portion of the sample was pipetted into a 100-ml beaker; one ml metanil yellow-indicator was added. The solution was titrated with 1 N sodium hydroxide until a yellow color was obtained. Ten ml PAR were added, followed by 20 ml of concentrated buffer solution. Calibration graphs based on iron were prepared using ferric and ferrous ammonium sulphates. They were found to be identical. All metals studied produced a color which was stable for at least 15 minutes. An analysis of a plating shop effluent both before and after treatment is given in tables. Optical density per wavelength curves and optical density per concentration graphs are shown. Data on optical densities and metals and their PAR factors are included.

**64-0687**

Lauria, D. T., and C. A. Willis. Treatment studies of combined textile and domestic wastes. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.45-58.

Pilot plants are often necessary to determine the treatability of the wastes and to obtain criteria for the most economical design. Pilot plant studies were performed to evaluate a low-loading, completely mixed biological process for the treatment of combined domestic and industrial wastes in the town of Valdese, North Carolina. Valdese has a population of 6,000; several textile mills produce more than 80 percent of the total waste flow from their dyeing and finishing processes. There are two sewage treatment plants, but the larger is not of sufficient capacity and is almost inoperable. The combined flow of sewage and wastes is 2 million gal per day, and, in 20 years, it is expected to be 4 million gal per day. A completely mixed, long-term aeration process was selected partly because waste loads are reduced on Sundays. The pilot plant consisted of: a 1,500-gal aeration tank and mechanical aerator (surface), both constructed of brick and plastered inside and out and made watertight; a settling tank with a sludge recycle pump; and a positive displacement pump with multiple-sized sheaves to feed waste from the holding tank to the aeration tank. Results indicate that BOD reductions of 90 percent can be obtained up to BOD loadings of at least 2.0 PPD BOD applied per lb of sludge. About 38 percent of removed BOD is oxidized, and 62 percent converted to new growth. The sludge endogenous respiration rate is about 8 percent per day. Oxygen requirements are about 0.55 lb per lb of removed BOD, and net sludge production of 0.35 lb of solids per lb of removed BOD. Because of an alpha factor of 0.5 and proposed aerating conditions, aerators must transfer an equivalent 3 lb of oxygen to water at 20 C and 0 mg per liter oxygen for each lb of oxygen required in the mixed liquor. For sludge removal the required settling tank loading is about 35 PPD sludge solids (dry basis) per sq ft of surface area. Excess sludge removal will be by centrifugation and landfill. The size of chlorine feed machines must be large enough to provide a dosage rate of 10 mg per liter. The estimated cost of the plant is $535,000 for a 3.2 mgd facility.

**84-0688**

Lawrence, A. W., P. L. McCarty, and F. Guerin. The effects of sulfides on anaerobic treatment. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.343-357.

The effects of soluble and insoluble sulfides on anaerobic treatment were studied in laboratory digestors receiving sulfide additions daily. After a discussion of the theory of the chemical relationships involved, the experimental results are presented in nine figures. Equilibrium concentrations of soluble sulfide up to 200 mg per liter sulfide had no significant toxic effects on anaerobic treatment with daily feed operation, but concentrations above 200 mg per liter sulfide produced severe toxic effects and complete cessation of gas production. These inhibitory concentrations of sulfides affect gas production first of all, and significant volatile acid accumulation takes place much later, only after gas production has been severely retarded. Iron can be used to 'inactivate' sulfides or reduce sulfide toxicity by precipitating sulfides from the biological environment. Insoluble iron sulfide has no significant effect on anaerobic treatment in concentrations of at least 400 mg per liter of sulfide. It was also observed that the concentration of sulfides in solution in the digestor is equal to the concentration of soluble sulfides and sulfide precursors entering with the waste, minus the amount of sulfides expelled with the digestor gas. The quantity of sulfides lost with the daily gas is related to the solubility of hydrogen sulfide, the digestor pH, and the relative daily gas production.

**84-0689**

Levin, G. B., and J. M. Barnes. Froth flotation for harvesting algae and its possible application to sewage treatment. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.421-434.

The possibility of harvesting only part of the algae and recycling the remainder in a continuous growth system has been investigated. Since successful operation depends on the viability of the algae in spite of exposure to the low pH of the harvester, the viability of cells repeatedly exposed to harvesting conditions was determined, and their subsequent growth in fresh media, and in supplemented, unsupplemented, and diluted harvest liquor recorded. The experimental procedures are detailed. Chlorella pyrenoidosa was inoculated into 700 ml of a urea medium and cultured for 10 days. A harvest-growth cycle was repeated five times with the only variable the length of the culturing period. It was found that the liquor does support growth of the algae, but not as well as the fresh medium. Whether the smaller amount of growth in the liquor cultures was caused by depletion of nutrients or a build-up of auto-inhibitory metabolic products was further investigated. The results of studies of the viability of cells harvested from urea medium and resuspended in fresh urea medium are reported in tables. Percent harvest, culture densities, and cost considerations are discussed. The harvesting of mixed algae cultures in two sewage lagoons in Falls Church, Virginia, is also reported. The principal conclusions from the study are that the froth flotation process approaches a level for the economical harvesting of algae for any purpose: mass production of food or fodder; use in spacecraft or closed ecological system; clarification of algae from oxidation pond effluent; and reclamation of algae in oxidation ponds for economic use. The method may have an application as a new sewage treatment process or as an adjunct to conventional processes.

**64-0690**

Lewis, J. W., and A. W. Busch. BOD progression in soluble substrates. VIII. The quantitative error due to nitrate as a nitrogen source. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.846-870.

Ordinarily the BOD test is run for 5 days, stopped, and ultimate or 20 day BOD values calculated. An excess of ammonia nitrogen is usually present, but the period is considered to be too short for significant nitrification to take place. In studying complex industrial wastes, the BOD test is frequently run for 20 days, and nitrification is a problem. The effects on the BOD test of the substitution of nitrate for ammonia as the nutrient nitrogen source were studied. The theoretical considerations are reviewed and discussed. A schematic representation of aerobic bacterial metabolism is given, and the valence states of nitrogen, and schematic representation of inorganic nitrogen metabolism is presented. The experimental procedure is described and illustrated. The findings are reported in 6 tables and 7 figures. The nitrate form of nitrogen is not a suitable source of nutrient in the BOD test. Any nitrogen form not of the ammonia valence will cause lower values of BOD when there is a requirement for nutrient oxygen. Nitrates are a suitable source of nutrient nitrogen in a bacterial growth system if the only requirement is that growth not be nutrient limited. When the nitrogen is provided in nitrate form, the nitrogen requirement for the metabolism of glucose is less. The use of BOD:N ratios is inaccurate, uneconomical, and misleading. We need a simpler method for the determination of the correct nitrogen requirement in a given waste, considering the particular form of nitrogen to be provided. The term 'chemical nitrogen' is inaccurate and misleading when it is applied to dissimilatory denitrification. The nitrogen is the oxidant and the degree of reduction of the nitrate determines the concentration of nitrate needed for the oxidation of a given amount of substrate. The term 'lag time' is frequently misused. If a lag time is to be determined in the BOD test, some factor, such as cell mass, which has a finite value at zero, must be determined. Data from a plateau BOD progression, with normal and semilogarithmic plots, yield much information not available from 5 day BOD.

**64-0691**

Listoe, M. J. Lynnwood sewage treatment plant reduces and incinerates sludge. Western City, 40(3):27-30, Mar. 1964.

The Lynnwood sewage treatment and disposal plant, located on a half-acre site, serves a population of 10,000; it is capable of serving 22,000 and can be enlarged to serve 60,000. This plant contains the first installation of a Dorr-Oliver FS Disposal System which is effective and economical in disposing of sewage and sludge without digestion. Lynnwood uses a centrifuge for sludge dewatering and a high temperature reactor for conversion of dewatered sludge to a sterile ash of about 1 percent of the sludge. Construction cost totaled $218,000. Lynnwood's new sewage system, construction because the old had two different drainage basins, includes 41 miles of new sanitary sewers and treatment facilities at a cost of $2,600,000.

**64-0692**

Lowry, J. A review of current improvements in drag type sludge collectors. Water and Sewage Works, 111(10):471-472, Oct. 1964.

Some current improvements in drag type sludge collectors are described. Any design features for improving the service life of chains should take particular account of the chain barrel since this is the area of maximum wear and when worn through requires chain replacement. A modification affecting chain life consists in curving the side bars to match the radius of the sprocket rim, and flanging the side bar both top and bottom to provide a substantial area of contact. Incorporation of this feature into the CS-720-S chain is described. In sludge collection, the load the conveyor must drag is largely its own weight, and hence a weight savings here is almost directly converted into longer chain life. One aspect of reduced conveyor loading is in the flight or drag itself, which is normally made from Redwood or Douglas fir lumbers. However, after about 6 months submergence, the lumber becomes waterlogged and will not float. Recently, a hollow, sealed extrusion of polyvinyl chloride fitted with snap-on wear shoes, has been developed. The combination of the CS-720-S chain with the polyvinyl chloride buoyant flight has much potential for increased conveyor life. The sliding friction of the conveyor system is drastically reduced on a permanent basis with substantial reduction of operating costs.

**64-0693**

Malina, J. F., and H. N. Burton. Aerobic stabilization of primary waste water sludge. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.716-723.

The data presented concern the breakdown of organic solids, the fate of nitrogenous compounds, and the environmental characteristics during aerobic stabilization of primary sludge. The apparatus and procedures are described and a schematic drawing of the laboratory scale digestor presented. The sludge samples were collected at the San Marcos Sewage Treatment Plant, San Marcos, Texas, fed through a 0.5-in. mesh wire screen, homogenized for 1 min in a blender, and stored at 4 C. Samples were analyzed weekly to estimate the concentration of total and volatile solids, ammonia, organic nitrogen, COD, alkalinity, and volatile acids, as well as the pH and ORP. An initial charge of 6 liters of the primary sludge, diluted to a total solids content of about 2 percent was added to each stabilization unit and aerated for 4 weeks to acclimatize the microbial population to the aerobic environment. Daily addition of water to make up for evaporation and changes in sludge volume from microbial decomposition maintained a constant sludge volume of 6 liters. The results are given in a table. It was found that primary waste water sludge can be stabilized effectively without the addition of any seed material. At a loading of 0.14 lb VS per day per cu ft the breakdown of volatile solids was greater than at a loading of 0.10 lb per VS per day per cu ft. About 43 and 33 percent of the volatile solids were degraded at the high and low loadings, respectively. The average pH of the effluent sludges was 8.0 for the low and 7.90 for the high loading. The aerobically treated sludge was relatively well oxidized, for the redox potentials were greater than +250 mv with respect to hydrogen at the two loadings. There is a release of dissolved organic matter which is used by the microbial population. The chemical oxygen demand of the treated sludge was 46 percent of the COD in the feed material at the higher loading. However, the supernatant after treatment contained between 18 and 28 percent of the COD of the supernatant of the feed material. Volatile acids concentrations in the effluent at both loadings were less than 26 mg per liter as acetic acid. Concentrations of ammonia and organic nitrogen in the aqueous phase decreased during aerobic treatment of sludge. About 98 percent of the dissolved nitrogen in the feed was removed at the low loading and about 94 percent at the high loading. Similar reductions in the concentrations of ammonia were observed. Trace concentrations of nitrites, and concentrations of nitrates almost equal to the ammonia content were found in the effluent supernatant, so nitrification of the ammonia was taking place.

**64-0694**

Mercer, W. A. Industrial solid wastes; the problems of the food industry. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.51-64.

Regardless of the degree of centralization and automation in food growing and processing in the future, the amount of inedible solid refuse can change little in proportion to edible portions of the raw food. In the field and at the processing plant much greater accumulations of wastes can be expected whose proper disposal or utilization will demand the best efforts of engineers, scientists, and all who are concerned with environmental health problems. At present, there exists an urgent need for aesthetically-acceptable, rapid, reliable, and economically-feasible methods for disposal or utilization of the wastes accumulated in the growing, harvesting, and processing of fruits and vegetables. It is an alarming fact that if open dumping or landfill disposal were suddenly prohibited, no alternative methods having established reliability and feasibility are available. A survey of other possible methods of disposal for these wastes indicated that high-rate aerobic composting should be investigated. A second phase of the current experimentation is investigating the mechanics of continuous composting. Research programs designed to establish the technology and feasibility of community-wide, area-wide waste management must be undertaken. To implement these waste management efforts, surveys must be made to ascertain the types of wastes occurring in a given area, the volumes of these wastes, and the time of the year when each is most prevalent.

**64-0695**
Mills, R. E. Process waste burner destroys liquid organic chemical wastes safely. Water and Sewage Works, 111(7):337-340, July 1964.

An open ground-level process waste burner installed by Dominion Rubber Company Ltd. at one of its plants to dispose of organic process wastes is described. The unit chosen was from National Airoil Burner Co., and employed primary and secondary refractories, cone air regulator, detaching gear, cylindrical gas pilot burner, and SAR 3 burner gun. A total of 150 tons of process wastes are disposed of through the burner annually. The bulk of the wastes can be grouped into three main classes of waste: chlorinated hydrocarbons, waste hydrocarbons, and waste alcohols. The initial cost was $2.966; the operating cost is reasonable ($0.0084 per lb of waste burned). Maintenance cost is higher than expected, due to pump corrosion (amounting to $1,200 per year). Steps are being taken to decrease maintenance. Burner operation is independent of wind direction, but the unit should not be operated during an atmospheric inversion.

**64-0696**
Newton, D. Thickening by gravity and mechanical means. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.4-16.

Thickening is the process of increasing the concentration of sewage solids after the initial separation from sewage, to reduce the liquid sludge volume to be handled in subsequent sludge disposal processes. Thickening by gravity means is essentially a sedimentation process. It occurs in all sludges after the initial separation of solids from the liquid phase in the zone of hindered settling. The solids particles agglomerate, water is rejected to some extent as the particles draw together and become denser, and the increasing density itself assist in consolidating the lower portion of the sludge blanket. This thickening action is relatively slow, as compared to the initial separation phase, and may require several hours. The common uses of thickening undigested sludge are: reducing the volume to reduce heating loads, to increase displacement periods, and to permit higher solids loadings per cu ft of digester capacity; reducing volumes of sludges to be hauled to sea; and increasing solids concentrations and reducing the chemical requirements for raw sludge disposal by vacuum filtration. The early developments and applications, and modern equipment and facilities are described. All the controlling factors of this type of thickening are not fully understood, but there is sufficient information to enable one to design and operate gravity thickeners in a satisfactory manner with much economy in the resulting sludge disposal processes. The operating results of 11 plants located around the United States are summarized in a table. Another table presents the gravity design factors, suggested for circular units, for various sludges and combinations. Equipment should be rugged, and submerged equipment should not have surfaces on which sludge can accumulate. Plunger pumps, in duplicate, are most suitable, and high discharge heads in the sludge piping can be expected. No cost statements are given since they vary greatly with local conditions. Unless power costs are favorable, gravity thickening and thickening by pressurized air flotation may cost about the same with initial cost favoring gravity thickening. Gravity thickening has a definite and continuing place in the handling and processing of sewage sludges.

**64-0697**
Oil refinery waste disposal. Water Works and Wastes Engineering, 1(11):47, Nov. 1964.

The wastewater disposal system at the new refinery of the Standard Oil Co. at Pascagoula, Mississippi, segregates all wastes according to quality and pollutant content. The three main segregations are: sanitary wastes; storm water; and process wastes. Process wastes are segregated based on their oil, ammonia, sulfide, and water-soluble organics contents. Oil contaminated water drains to one of two oily water sewer systems. Each system has a multi-channel, API-type oil-water separator. Process wastewaters highest in ammonia and hydrogen sulfide are steam stripped. The stripper bottoms are combined with other ammonia and sulfide-containing waters, and fed to a sulfide oxidizer to remove more ammonia and oxidize essentially all of the sulfides. The wastewater streams from the oil-water separators, the sulfide oxidizer, and the sanitary wastes from septic tanks are combined. After pH adjustment, they are fed to a biological oxidation pond for oxidation of organics. A separate system has been provided for a large volume stream involving a short-time discharge--about every two years. This stream, high in sodium sulfite, is stored in a chemical oxidation pond until its oxygen demand has been satisfied. Controlled dilution water is provided in the refinery effluent canal to further lower pollutant concentrations.

64-0698

Olson, O. O., W. van Heuvelen, and J. W. Vennes. Aeration of potato waste. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extensions Series No. 117. p.180-194.

Lagoons are used extensively in North Dakota to treat domestic waste. Only one major community does not use lagoons and 159 do. The design standard is a 5 day BOD loading of 20 lb per acre per day with 120 days retention. One acre is required for each 100 population. The liquid depth is from 3 to 5 ft. An experimental aerated lagoon was constructed at Park River to pretreat the combined waste of a small potato-flake plant and the domestic wastes from a town of 1,800. Before the construction of the new lagoon there were two in use: one of about 24 acres, and the other of about 8. A 25 HP Vortair aerator was installed in the one-acre cell, and the raw waste brought in below it. Theoretically, 2,250 lb of oxygen per day are provided in the cell and, with an 8 ft liquid depth, retention time varied from 1[illegible] days for domestic waste to 6 days during potato processing. Normal domestic sewage treated in this cell exerted a 5 day BOD loading from 192 to 438 lb per acre per day. Studies of the operation of the unit showed that it could be loaded at about 300 lb per acre per day and still provide about 90 percent BOD reduction even when the temperature was less than 5 C. During the potato-processing period, when caustic was used, the waste strength increased to 2,500 lb BOD per day, and the pH was 11.6, which prevented any reduction, since few organisms can grow in this alkalinity. Because the processing period lasted only 3 weeks there was insufficient time to adjust the pH. A study will be made of the effects of circulating waste from the primary lagoon to the aerated cell to maintain a pH of 10 or less during the potato-processing period. The installation of an aerator at Grafton during the winter months is described and, although it does not supply adequate oxygen for complete stabilization of the organic matter present, it does reduce sludge accumulation in the area of the inlet, supplies oxygen throughout the lagoon in the winter, and thus maintains an active algae population.

64-0699

O'Rourke, J. T., H. D. Tomlinson, and N. C. Burbank. Variation of ORP in an activated sludge plant with industrial waste load. Water and Sewage Works, 111(11):R318-R324, Nov. 30, 1964.

Oxidation-reduction potential (ORP) measurements were studied as a method for control of operations in an activated sludge treatment plant employing the Kraus nitrification process. Measurements were taken using an ORP meter, with the electrodes being checked before each observation by reference to a quinhydrone solution at two pH values. Flow rate and organic loading rate as measured by chemical oxidation demand (COD), and air supply as measured by dissolved oxygen (DO) were also selected for study. It was found that a 15-fold variation in organic loading created a significant variation in ORP and DO. ORP values in the aeration basin ranged from a minimum of -5 to a maximum of +130 millivolts, and the DO varied from 0 mg per liter to a high of 6.2 mg per liter. A review of the ORP and DO data, relating particularly to the aeration basin, indicated that the plant was operating at a level during the week which utilized practically all of the aeration capacity, whereas on weekends there was excess aeration capacity. By use of the ORP it would be possible to adjust the volume of air supplied to suit the need of the organic load. The ORP electrode coupled with the DO electrode, relayed to a visible meter on a control board, gives a plant operator an immediate view of biological operations, as well as an indication of the variation in load coming to the plant. Since the measurement of rate of change of ORP to indicate the activity of mixed liquor was demonstrated, it was suggested that ORP electrodes, with certain specifications, be made commercially available as a valuable diagnostic and control tool for sewage treatment.

**64-0700**
Pialthorp, R. E. Potato waste treatment. In Proceedings; Eleventh Pacific Northwest Industrial Waste Conference, Corvallis, Oreg., 1963. p.101-109.

A discussion is included on the water pollution from potato processing plants in Idaho, whose capacity has increased ten fold in ten years to 2½ billion lbs per year in 1961. Approximately ½ billion lb of this is waste, much of which in the past has been run into rivers. Feeding of filtered or salvaged potato waste to livestock is now practiced. Research is needed to find other used for the 300 million lb of potato material to be collected from the waste water before dumping into Idaho's rivers.

**64-0701**
Parkhurst, J. D., and S. R. Sanders. Centrifuging and screening of sludge. Water and Waste Treatment, 9(12):596-598, Mar.-Apr. 1964.

The sludge processing method employed by the Los Angeles County Sanitation Districts is discussed. Prior to 1959, the digested sludge was processed on open drying beds, but odors began to present a serious problem to neighboring residential developments. In 1959, based on a year test operation, a sludge dewatering station was established which employed five 40 by 60-in. centrifuges without the use of chemicals or thickening agents. A system of vibrating screens provides a centrifugate suitable for ocean disposal, if desired. Sludge centrifuging may take place either prior to or following the screening operation. During fertilizer production, the sludge cake is hauled to the adjacent drying area. The thickness of an odor-preventing sawdust cover is determined by the condition of the sludge. Combined operating and maintenance costs of the station average about $4.00 per dry ton of recovered solids. A present average of 1 million gal of liquid sludge is being processed each day. In addition, space requirements are low, and no chemical pre-treatment is necessary.

**64-0702**
Pepperl, H. Incineration of electroplating sludges by means of a conical furnace. Brennstoff-Waerme-Kraft, 16(8):399-401, Aug. 1964.

Sludges formed during electroplating processes cannot be simply dumped, because of their toxicity. These sludges contain metal hydroxides and cyanides. Before incineration, the water content of the sludge is reduced to about 60 percent using a filter press. The residue is then burned, together with chips of wood at temperatures between 900 and 1100 C, in a conically shaped rotating furnace. In this way the metal hydroxides are converted to metal oxides and organic compounds are destroyed. The ashes can be deposited safely in dumps. A sludge incinerator located in an automobile plant in Bavaria is described and presented in photographs and schematic drawings. It is capable of handling up to 8 tons of sludge daily. (Text-German)

**64-0703**
Pfeffer, J. T., and J. E. White. The role of iron in anaerobic digestion. In Proceedings; 19th Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.887-901.

A study has been made to determine the role of iron in anaerobic digestors using synthetic substrate which consisted of glucose, ammonium chloride, potassium dihydrogen phosphate, and sodium hydrocarbonate dissolved in tap water. The substrate initially contained 4.0 g per liter of glucose and sufficient nitrogen and phosphorus salts to produce a C:N:P ratio of 100:5:1. Sodium hydrocarbonate was added in sufficient quantities with the substrate to maintain the pH in the digestor between 6.5 and 7. The substrate was added to the digestor at the rate of 0.5 liter per day. Each digestor had a capacity of 7.5 liters and a retention time of 15 days. The following salts were used: ferrous chloride; aluminum chloride; and calcium chloride. They were added daily on a batch basis. The addition of iron in proper concentrations to digestors fed synthetic substrate produced efficient digestion. The role of the iron is one of reducing the soluble phosphate concentrations in the digestor by chemical precipitation. A definite relationship exists between the fermentation of the volatile acids and the soluble phosphate concentration. The most effective digestion took place when the soluble phosphate concentration was less than 50 to 60 mg per liter. The addition of proper concentrations of aluminum and calcium produced the same effect as the iron. But excessive concentrations of any salts tested resulted in reducing the soluble phosphate to such a low concentration that microorganisms were unable to metabolize the substrate because phosphorus was limiting.

**64-0704**

Pohland, F. G. General review of literature on anaerobic sewage sludge digestion. Purdue University Engineering Extension Series No. 110. Lafayette, Ind., 1962. 45 p.

A literature review is directed toward a discussion of available information concerning the two phases generally considered responsible for anaerobic decomposition and methods utilized for control of the process. Cognizance of the importance of the physical, chemical, and biological factors influencing sludge stabilization has stimulated numerous investigations into the basic concepts of anaerobic digestion in an attempt to lead to a better understanding of the process. Sludge digestion is regarded in terms of two main and entirely different processes: the first, liquefaction and hydrolysis; the second, fermentation and gasification. The former process is assigned the function of rendering the complex and larger sized materials into forms more readily available for methane fermentation organisms, which take part in the latter process and convert the liquefied and hydrolyzed materials into methane and carbon dioxide. The preliminary stage and subsequent gasification must work in harmony or the whole process of digestion is upset. The factors leading to liquefaction, and gasification and the factors affecting anaerobic digestion and their control are discussed.

**64-0705**

Pohland, F. G., and R. J. Engstrom. High-rate digestion control. I. Fundamental concepts of acid-base equilibrium. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.80-90.

The origin, relationships, and significance of the acidic and basic constituents of digestion are reviewed with special emphasis on periods of retarded digestion. As organic material is decomposed and transformed during digestion, several intermediate and end-products accumulate and predominate. Hydrolysis of fats and oils, and fermentation of carbohydrates and proteins give rise to the intermediate organic fatty acids of which acetic, propionic, and butyric are the most abundant. The relative concentrations of these are dependent upon digestion conditions. The organic acids are fermented to methane and carbon dioxide, usually by the beta oxidation mechanism. Decomposition of proteinaceous material produces ammonia as hydrolysis and deamination of the constituent amino acids take place. Ammonia will ionize in solution and participate in the equilibrium established between itself and the acid products of digestion either as an acid-salt or as a bicarbonate alkalinity. This bicarbonate alkalinity and the organic acids are a significant part of the acidic and basic constituents accumulating during anaerobic digestion. Alkalinity insufficient to neutralize the accumulated organic acids is the major cause of pH depression during retarded digestion. If the concentrations of free acids and the buffering potential of the system are known, neutralization requirements can be determined. The buffering potential is dependent upon the types and concentrations of acids and bases present and their associated equilibria. The most important acid-base equilibrum during retarded digestion at a low pH is between representative organic acid, acetic acid, and its acid-base counterpart, ammonium acetate. The best way of determining acid-base equilibria during digestion is by evaluating the concentrations of acids, bases, salts and their ionization in solution and effect on pH response.

**64-0706**

Prakasam, T. B. S., and N. C. Dondero. Observations on the behavior of a microbial population adapted to a synthetic waste. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.835-845.

Experiments were carried out to determine if acclimated sludge shows the true heterogeneity of typical activated sludge, which remains stable through the reported diauxic phenomenon, and thus confirming the concept of diauxic or biphasic growth. The experimental design is described, and the plating of settled sewage, activated sludge, or adapted sludge is shown in a figure. Tables give the results of bacterial counts for settled sewage, activated sludge, and adapted sludge. It was concluded that the sorbitol-adapted sludge system described in these studies is not typical of activated sludge. The sludge that was developed in the adaptation medium was not flocculent in nature. The system was far from physiological heterogeneity as was indicated by replica plating studies and differential test (IMViC) for coliforms, which showed that all the viable plate counts represented coliforms solely. The development of such a system may be partly attributed to the composition of the basal medium, which should not be considered a substitute for domestic waste nor as a growth medium for the heterogeneous population of sewage or activated sludge. The selectivity of the medium also narrows down the population of sewage, harboring the species that can thrive in the basal medium, the so-called 'synthetic waste'. Though this system is similar to that reported by others, its behavior is such that caution should be used in applying or interpreting results obtained with such a model to biological waste treatment processes like the activated sludge process.

**64-0707**
Pump-cyclone solves solid waste problem. Factory, 122(10):187, Oct. 1964.

A combination pump-cyclone arrangement handles waste containing fine solids (abraded mixture of sand, aluminum oxide). Drum polishers discharge medium into a channel through a filter. The pump takes the polishing medium and feeds it into a cyclone which separates the solution. Solids remain in a settling tank and liquid is passed to the sewer.

**64-0708**
Purdue University. School of Civil Engineering. Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Engineering Extension Series No. 117. 1084 p.

The Nineteenth Industrial Waste Conference was sponsored by Purdue University in conjunction with the Indiana State Board of Health. Certain agencies of the State of Indiana also supported the Conference. Seventy-nine papers were presented. The first part of the conference dealt with the operation and control of water pollution control facilities and the papers covered a wide range of topics within that general area. The second part dealt with basic research on the physical, chemical, and/or biological phenomena of waste treatment processes. In this part of the Conference, such topics as the acute toxicity of some heavy metals to different species of warm water fishes, an automated BOD respirometer, and electrodialysis in waste water recycle were discussed. There are many charts, graphs, and photographs throughout and many of the papers have extensive bibliographies.

**64-0709**
Quirk, T. P. Economic aspects of incineration versus incineration-drying. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.158-176.

Recovery of the costs of sewage treatment is possible by three means: the generation of electricity; the sale of treated effluent; and the sale of sludge as a soil conditioner. The sale of sludge probably receives the most attention in planning. Site limitations or the comparable cost of alternate sludge disposal methods may require the evaluation of thermal disposal. Evaluation of the relative economics of incineration versus drying is pertinent to the selection of the final flow sheet. Selection of the more costly, dual-purpose flow sheet should be based upon a detailed analysis of market demands and selling price. Economic justification should be established for a range of market conditions in accordance with the anticipated variation in local demands. High-temperature deodorization is costly, and its effect on site evaluation and selection of an alternate flow sheet requires careful study. Economic justification for the incinerator-drying system requires sufficient product income to defray the additional costs required over systems which offer no possibility of cost recovery. A comparative cost technique is presented that may provide an economic basis for flow sheet selection. This technique may prove useful in other applications. Specific costs were analyzed for a medium-sized installation. Alternate flow sheets included multiple hearth and flash drying equipment. Average costs for both systems show that: (1) full cost recovery should not be expected; (2) a deodorization requirement will exert a significant influence on the market conditions required to justify an incinerator-drying flow sheet; and (3) a demand for at least 25 percent of the annual sludge production would justify an incineration-drying flow sheet under the extremes of operating cycle and selling price.

**64-0710**

Rasmussen, A. E. Digestors beat incineration. American City, 79(12):100-101, Dec. 1964.

The new sewage treatment plant in Sioux City, Iowa, which employs digestors and sludge beds, was chosen over two other types because of its low operating costs. The installation consists of four 75-ft diameter digestors. Two are used as settling tanks. Partially digested sludge flows from them to the main digestors. The decomposition of this sludge results in the production of sewage gas which is sold after it has gone through a scrubbing procedure. This returns a profit of about $7,500 a year. In deciding to use this type of plant, two other possibilities were considered, a vacuum filter incinerator, and a sludge thickener with incineration. A table is given which supplies the total financing of all three plants considered. The sewage gas purifier is a conventional type using wood chips impregnated with iron oxide to oxidize hydrogen sulfide gas produced. A new method of rejuvenating the wood chips allows them to remove three times as much sulphur as the old methods. A technical explanation is presented.

**64-0711**

Recent developments in chemical industries relating to ethyl alcohol, its byproducts and wastes. Journal of Scientific and Industrial Research, 23(4):129-131, Apr. 1964.

A summary of the Symposium on New Developments in Chemical Industries Relating to Ethyl Alcohol, Its Byproducts and Wastes, held in New Delhi, Oct. 14 to 16, 1963, is given. The results of studies presented in a number of papers at the symposium were classified for convenience of discussion as follows: (1) economy of energy means; (2) equipment for production of ethyl alcohol and its byproducts; (3) automation and instrumentation; and (4) industrial utilization of alcohol, its byproducts and wastes. Some comments are made about the cost of producing acetaldehyde from petro-ethylene as compared with alcohol. The other papers presented dealt with the production of acetic acid from alcohol, the activity of alumina catalysts during dehydration of alcohol to ethylene, the use of alcohol in the production of pesticides, and alcohol as a source of various organic chemicals.

**64-0712**

Reverse procedure--pumping into a well. Public Works, 95(9):84, 86, Sept. 1964.

The Hammermill Paper Co. has completed the first of a proposed series of deep wells costing about $400,000 each, which promise almost unlimited capacity for disposal of untreated effluent from the company's pulping operations. The well, which will carry daily 500,000 gal of pulping liquor to a brine-bearing limestone formation some 1,600 ft below the surface, is the first of four wells designed to handle some 2 million gal per day. A second well is now being drilled to an even deeper formation that may provide many times the capacity of the first. In order for a deep disposal well to meet the requirements of the State of Pennsylvania for this type of use, at least four requisites must be met: (1) absolutely no usable water, gas, oil, or other valuable mineral deposits can be in evidence while drilling the well; (2) there must be an adequate cover of impermeable rock above the limestone formation; (3) the limestone formation must contain brine to indicate that it is of no value; and (4) the brine must have a hydrostatic pressure to indicate that the formation is tightly sealed and not draining into some other strata. All of these requirements are met in the first well. Nevertheless, Hammermill's research department is continuing its search for an economical method to treat the effluent, to recover the significant value of chemicals which are lost in the deep well disposal method.

**64-0713**

Riebel. A new method for the removal of sludge from drying beds. Staedtehygiene, 15(11):256-258, Nov. 1964.

In the municipal sewage treatment plant of Giessen, West Germany, the dry sludge was loaded manually on trucks. Considerations of costs and availability prompted the city administration to replace the manual labor by power equipment. Tests of commercially available power shovels, however, proved unsatisfactory. Therefore, a new power shovel was designed. The basic equipment is a 4.2 ton tracked bulldozer. The specially-designed shovel of 850 liter capacity is 2450 mm wide, which is half the width of the drying bed. Steel teeth at the front edge and rubber rollers in the rear ensure that only sludge and no gravel is picked up. To support the bulldozer, paths had to be built into the beds. They consist of 30 cm wide concrete slabs hinged together. The power shovel can clear 12.5 beds per day at a cost of 27.20 DM per bed. Manual labor would have needed 12.5 days at 236.00 DM per day. Thus the city of Giessen will save annually about 100,000 DM. The power shovel is shown in action in five photographs. (Text-German)

**64-0714**
Rotondo, V. J. 'Honey wagon' sludge disposal. Water Works and Wastes Engineering, 1(8):59-60, Aug. 1964.

A method of eliminating the detrimental effects of discharging 'honey wagon' sludge into the main wastewater treatment units of an activated sludge plant is described. The 'honey wagon' sludge was degritted by use of a 12 in. DorrClone, a hydroclone capable of removing grit down to 150 mesh. The heavy solids in the degritted sludge are allowed to settle in a 5,000 gal storage tank until the contents can be pumped directly to the digester. The elimination of the 'honey wagon' sludge from the primary treatment unit removed the biological overload and complaints of odor from neighbors. Satisfactory disposal facilities are available for private septic tanks and the treatment plant has controlled its odor problem.

**64-0715**
Rubin, E., R. Everett, J. J. Weinstock, et al. Contaminant removal from sewage plant effluents by foaming. Public Health Service Publication No. 999-WP-5. Cincinnati, U.S. Public Health Service, Dec. 1963. 56 p.

A review of foam separation, preliminary batch experiments, continuous-feed foaming experiments, tandem continuous-feed foaming of secondary effluent, contaminant removal capability and miscellaneous investigations are discussed. The feasibility of employing a foaming process to remove refractory materials from secondary effluents using both batch-foaming and continuous-feed-foaming techniques were investigated. A correlation has been demonstrated between residual alkyl benzene sulfonate concentration and the volume of aeration air available per unit mass of ABS in secondary effluent. A 10 to 45 percent diminuation on COD was observed after foaming was performed. Some evidence exists that COD removal increases as surfactant concentration in secondary effluent decreases. Efforts to enhance the contaminant removal obtained by foaming through the addition of surface-active and/or non-surface-active materials have been unsuccessful to date. Total dissolved solids and chloride ion have been found to be unaffected by the foaming process. An increase in pH upon foaming suggests that weakly acidic substances are being removed.

**64-0716**
Russell, R. A. Theory of combustion of sludge. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.152-157.

Incineration has the dual purpose of reduction of volume and sterilization of the solid end products of the disposal process. The incineration characteristics of sludge include: moisture, volatiles, inerts, and calorific value. The sewage plant operator has some control over moisture, and the thermal load which its presence puts on the drying phase of incineration has a resulting effect on the auto-combustibility of the sludge. Inerts are to some extent controlled by the degree to which conditioning chemicals are added as an aid to vacuum filtration. Volatiles and inerts both affect the calorific value of the dry filtered cake. Incineration equipment must be designed to handle a sludge having a wide range of qualities, since the characteristics are variable. The incineration process is described in terms of the thermodynamics of the drying process which may be divided into three phases: raising temperature of filter cake to 212; evaporating water from filter cake; and increasing water vapor temperature to incinerator exit gas temperature. A typical example is given in which the entering sludge cake temperature is 60 and the incinerator discharge gas temperature is 600. The absorptions which occur for 1 lb of filter cake moisture in terms of Btu per lb are given. The thermodynamics of the combustion process are described, and the basic combustion equations are given. Other topics discussed are: excess air; combustion; furnace explosions; odor production; and secondary combustion problems.

**64-0717**

Salotto, B. V., E. F Barth, W. E. Tolliver, et al. Organic load and the toxicity of copper to the activated sludge. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.1025-1034.

The pilot plants used were designed for complete treatment of sewage employing primary settling, aeration with continuous sludge return, and secondary settling. Sewage was fed at a constant rate. Sludge from the secondary settler was pumped to the first chamber of the aerator at a rate of about 35 percent of the sewage flow. Sludge-wasting rates were adjusted to hold mixed-liquor volatile-suspended-solids concentrations at 1,000 to 1,200 mg per liter. Total detention time was 9 hr with a flow of 100 gal per day. Three identical pilot plants were operated in parallel. One unit received undiluted sewage at a constant rate. One unit received undiluted fortified (homogenized fish meal) sewage at a constant rate. Copper sulfate solution was introduced at the sewage feed inlet continuously. The other two units were fed the same sewage diluted about 2:3 with tap water. The effects of two copper concentrations were studied at each organic load level. The 5 mg per liter copper run lasted about 6 months and was followed by the 1 mg per liter copper run which lasted about 2½ months. The experimental conditions are summarized in a table; and the methods of sample collection and analysis described in detail. The results are presented in 7 tables and 5 figures. Moderate variations of organic loading did not significantly affect the toxicity of copper to the activated sludge process under these experimental conditions. Increasing the organic load increases the COD of the effluent. The effect of 5 mg per liter copper fed continuously to a low-organic loaded unit had about the same effect on COD of the effluent as doubling the organic load. The suspended solids in the final effluent were higher than expected with activated sludge treatment. Organic loading altered the distribution and form of metal during the 5 mg per liter copper studies. The unit receiving the high organic load was more efficient in the removal of copper and produced a higher ratio of soluble to total copper in the process effluents.

**64-0718**

Schraufnagel, F. H. Waste disposal by ridge and furrow irrigation. M.S. Thesis, University of Wisconsin, Madison, 1963. 50 p.

An evaluation of the ridge and furrow irrigation as a method of waste disposal is reported. The limitations and potentials of the method are discussed. Prior to 30 years ago little use was made of ridge and furrow irrigation exclusively for the disposal of industrial wastes. In the 1930's, several vegetable canning plants in Iowa began using this method. During the past 10 to 12 years about 40 milk plants in Wisconsin and Minnesota installed ridge and furrow systems, and the method has been used to treat a variety of other liquid wastes. Since 1950 some waste disposal fields have been replaced by spray irrigation. Others continue to operate satisfactorily, producing virtually a complete degree of treatment with little effort. There are, however, some unsatisfactory systems. The various waste disposal systems and related aspects are presented. Conclusions are enumerated. Where conditions are suitable, ridge and furrow irrigation of putrescible organic wastes can accomplish a high degree of treatment of low cost and with little maintenance.

**64-0719**

Sedimentation practices for paper industry wastes; progress report. Committee on Industrial Waste Practice. Paper No. 4165. Journal of the Sanitary Engineering Division, American Society of Civil Engineers, 90(SA6):41-49, Dec. 1964.

A questionnaire was sent to 75 separate paper industry mills to determine: (1) quality of waste waters; (2) design characteristics of sedimentation facilities including detention time, overflow rate and solids loading; (3) types of treatment in use; (4) efficiency of sedimentation; (5) type of construction of sedimentation basins; (6) sludge characteristics; and (7) sludge disposal methods. A total of 27 replies (36%) was received. Tabulated and graphically presented data indicated that: (1) raw waste water from paper industry mills is widely variable as to the quality characteristics of BOD and suspended solids, even among mills producing similar products; (2) in many cases sedimentation alone is extremely effective in the purification of paper industry waste water; (3) no correlation could be found, on an overall industry basis, or on a mill product basis, between purification results and the calculated design factors of detention time, overflow rate, and solids loading, for operating plants; and (4) sedimentation design is a separate problem for each mill.

**64-0720**
Seminar on sewage sludge and waste. Wasser und Abwasser, 105(14):369, Apr. 3, 1964.

The Workgroup for Municipal Waste Disposal will hold a seminar on 'Sewage Sludge and Solid Waste' at the Technical Academy in Wuppertal from April 27 to 29, 1964. The preparations for the meeting are conducted by Mr. Rosenberg. (Text-German)

**64-0721**
Senn, M. J., and E. M. Wylie. We must stop contaminating our water. U.S. Public Health Service, Jan.-Feb. 1963. 7 p.

Discoveries of the outbreaks of infectious hepatitis and detergent suds problems plaguing many communities indicate that the perils to health from polluted water are steadily increasing. Aside from the pollution of rivers and streams, there is the contamination of underground water by the wastes and chemicals poured into the soil by sewage systems, industry, and agriculture. The most-immediate concrete action that can be taken is the rigid control and eventual elimination of private septic tanks in the densely populated areas surrounding cities. Many of the municipal waste treatment processes in use today were designed for the wastes of forty years ago. Ships and boats that abound in lakes, rivers, and coastal waters usually do not have facilities for the treatment and disposal of shipboard sewage. Pesticides and herbicides scattered over crops, lawns, and trees can permeate the soil and underground waters and may reach reservoirs of drinking water. Ten questions are asked on the topic, 'How Safe is Your Water Supply?', and appropriate literature is suggested. (Reprinted with permission from American Home, January-February 1963)

**64-0722**
Shannon, E. S. Handling and treating petrochemical. Water and Sewage Works, 3(5):240-245, May 1964.

The waste control policy of a petrochemical complex places primary responsibility for control and treatment of wastes upon the various plants' operating superintendents. Waste control is considered an operational cost and receives the same attention as product production. The waste control department monitors the wastes of various plants, and acts as a consultant to the operating supervision and engineering department on waste control problems in existing plants, and on features concerning waste control in designing new plants. Data shows the distribution of a petrochemical barrel, the cracking process, ethylene purification, and butadiene finishing. The refinery complex operates under an order restricting the discharged waters to contain not more than 5 lb per day phenol, 15 ppm oil, and the pH to be between 5.8 and 10.3. The plant was designed for tight waste control. Sewers are separated into uncontaminated cooling water, process water, sanitary sewage, chemical wastes, sewer which can receive copper compounds, and surface run-off. Special cooling water systems were constructed. Process wastes, consisting of about 250 gpm, are pretreated in an A.P.I. separator equipped with a pre-aeration step. This step breaks oil emulsions, separates carbon from oil and strips lighter hydrocarbons from the water waste. About 40 percent of the total COD load is removed here. The combined wastes are pumped over one or two biological towers. The second is used as a polishing filter in series with and following the activated sludge step. Various problems were encountered and solved.

**64-0723**
Sherbeck, J. M. The operation and maintenance of a multiple hearth type incinerator. In Sludge concentration, filtration, and incineration. Ann Arbor, University of Michigan, School of Public Health, 1964. p.177-185.

Two factors determine the efficient operation and maintenance of an incinerator, the materials used in construction and the design. The operation of a multiple hearth incinerator is reported. It is a 14 ft 3 in. diameter, 6 hearth incinerator, 24 ft 4 in. high with individual hearth sizes from 3 ft 4½ in. to 2 ft 3 in. The larger hearths are on top to accommodate the unburned bulk. Each hearth is on top to accommodate the unburned bulk. Each hearth has a set of arms extending from a center shaft. The center shaft rotates counterclockwise. The arms are equipped with teeth arranged to move the sludge in and out alternately through the incinerator. The teeth also plow and turn over the sludge, leaving a 4 in. layer of ash on each hearth. Oxygen is obtained through a blower which produces 1,550 cu ft of air per minute. The ash after having been rabbled to the number 6 hearth drops into a 500 gal tank of water for disposal. The slurry formed is pumped to a lagoon every 30 minutes. The incinerator is designed to handle 3,250 lb per hr of wet cake containing 65 percent moisture and 70 percent volatile solids. The ash handling equipment is designed to remove all ash and pump it to a lagoon 1,500 ft away. The procedures used in starting up are given in detail. The daily record form that is used is shown in a figure. Operational problems are discussed and illustrated. Maintenance problems are outlined.

**64-0724**
Simple separator solves sludge-disposal problem. Chemical Engineering, 71(25):102, Dec. 7, 1964.

The DCG (Duel Cell, Gravity) solids concentrator, a continuous filter that operates by gravity, is described. It requires no vacuum or pressure, and no sludge conditioning by lime or ferric chloride. Dewatering is accomplished in the first nylon mesh cell and cake formation in the second. This unit is available in four sizes.

**64-0725**
Simpson, G. D., and S. H. Sutton. Performance of vacuum filters. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.126-138.

Seven vacuum filter plants of different sizes and types have been studied. The criteria for the evaluation are described and discussed and the results of the study presented in tabular form. The plants are: (1) Cleveland, Westerly; (2) Dayton; (3) Cleveland, Southerly; (4) Cincinnati, Mill Creek; (5) Indianapolis; (6) Minneapolis-St. Paul; and (7) Detroit. General data are given for each of these, including the type of sludge, the average number of tons of sludge solids per day, the total solids concentration in percent, the volume content in percent, and the alkali as calcium carbonate mg per cu liter. The number, size, total area, media type, and mesh of the filters used are given. The filter loadings and performance are given in a table. Included are the period of the study in months, the total dry solids load in tons, the chemical doses, the yield, the filter operating hours, and the total solids removed by filter in percent. The characteristics of the filter cake and filtrate are given in another table. Costs are also given. The data presented illustrate well the differences to be found associated with type of sludge, the size of the plant, and other pertinent factors.

**64-0726**
Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. 187 p.

These papers were presented at the Inservice Training Course on Sludge Concentration, Filtration, and Incineration in 1963. Among the subjects discussed were: thickening by gravity and mechanical means; dissolved air flotation as a method of thickening; elutriation and chemical coagulation as methods of thickening; processing thickened sludge with chemical conditioners; vacuum filtration; the operation of vacuum filters; centrifugal dewatering; the combustion of sludge; the relative economics of incineration and incineration-drying; and the operation and maintenance of a multiple hearth type incinerator. Charts, diagrams, and photographs are used to illustrate the papers.

**64-0727**
Sludge disposal system. Water and Waste Treatment, 10(3):151, Sept.-Oct. 1964.

The F-S Disposal System which provides a controlled process for the complete disposal of organic sludges by combustion in a fluidized bed is described. Thickened sludge which has been dewatered in a rotary vacuum filter is fluidized in an upward moving stream of air. The fluidized air is provided by suspending an inert sand bed within the reactor. A rapid combustion occurs as a results of the immediate dispersion of the solids in the sand bed. The reactor operates at 2 psi from 1300 to 1,600 F. The final effluent from the sewage treatment can be used in the scrubbers for the combustion gases. The system has the advantages of low area requirements, low maintenance cost, no odor, and no pollution. Sludge handling problems are minimized because the reduced volume of inerts can be disposed of simply and inexpensively.

**64-0728**

Smith, Lloyd L., and R. H. Kramer. Some effects of paper fibers in fish eggs and small fish. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.369-378.

Many estuaries and rivers receive large quantities of bark, groundwood, and chemical pulp wastes from paper mills. The present report is on the effects of various wood fibers on: (1) the survival of rainbow and brown trout eggs; (2) survival, growth, and vigor of trout alevins; (3) growth of trout juveniles; and (4) survival and indicators of stress in walleye fingerlings and adult fathead minnows. Materials and methods are described. It was found that brown and rainbow trout eggs incubated in 60, 125, and 250 ppm suspensions of conifer groundwood had a 95 to 98 percent (brown trout) and 98 to 100 percent survival in all treatments. The effect of conifer groundwood at levels of 0, 60, 125, and 250 ppm on trout alevins was tested by noting growth, respiratory rate, and rate of oxygen uptake. Survival rate descreased rapidly with increase in fiber load, and reached zero in one lot of rainbow trout at 250 ppm of fiber. Growth was markedly decreased as fiber load was increased: from .0213 in controls to .0062 at 250 ppm in brown trout; from .0345 in controls to .0061 at 250 ppm in rainbows. Rate of oxygen uptake declined markedly as fiber concentrations rose and corresponded to the decline in respiratory rate. Subsequent growth of the alevins in clear water as juveniles was reduced. Fathead minnows kept for 96 hr in suspensions of aspen groundwood from 0 to 2,000 ppm at oxygen saturation showed no significant effects. With conifer groundwood a similar series showed increased mortality at 738 and 2,000 ppm. At reduced oxygen levels significant changes in fathead survival were observed as fiber loads increased in only one case with aspen groundwood. Walleyes tested with reduced oxygen levels showed marked decrease in survival as fiber levels increased. These effects were most acute with conifer groundwood where there were no survivors at 272 ppm, and 20 percent survival at 74 ppm.

**64-0729**

Stahl, R. W. Survey of burning coal-mine refuse banks. U.S. Bureau of Mines Information Circular No. 8209. [Washington], U.S. Department of the Interior, 1964.

Refuse banks may be ignited by the following means: spontaneous ignition, careless burning of trash, forest fires, camp fires, and intentional ignition. All except spontaneous ignition can be eliminated by patrolling the disposal area. Sealing outer surfaces can minimize spontaneous ignition. Fires can be extinguished by flooding the bank with water, covering with a mantle of smothering material, pumping limestone slurry into boreholes, water sprays, isolating the area, or compacting and sealing the area. Fencing the disposal area, proper construction, and elimination of paper, timber, and burnable trash can prevent most fires. Maps of mining areas and a figure showing geographic distribution by state are included. West Virginia has 213; Pennsylvania, 117 bituminous and 25 anthracite; Kentucky, 49; and Virginia, 27. Tables give the following data on the 495 banks in 15 states surveyed: county; name, population and distance of nearest town; size and status of bank; status and stage of fire, and topography. Fifty percent of the banks are in the late burning stage; 40 percent are within 1 mile of a town.

**64-0730**

Sussman, V. H., and J. J. Mulhern. Air pollution from coal refuse areas. Journal of the Air Pollution Control Association, 14(7):279-284, July 1964.

Although coal refuse disposal piles have been burning and causing air pollution since coal mining first started, little has been done to control these fires. They have been regarded as an unavoidable and natural by-product of coal mining, and it was believed there was no means of averting such fires. A chart indicates the extent of the problem, showing the increase in refuse production while the coal production remains constant. Twenty percent of the 65 million tons of bituminous coal produced in Pennsylvania and 20 to 50 percent of the raw anthracite in Pennsylvania was rejected as refuse. The coal refuse with less than 25 percent combustible contains coal, slate, shale, bone, calcite, gypsum, clay, pyrite, and marcasite. It is dumped in piles from 20 to 300 ft high which may contain millions of tons. These piles are ignited by spontaneous combustion, carelessness, or intent. The ignition results from oxidation of carbonaceous and pyritic material in the refuse which, in the presence of air, produced enough heat to ignite the piles, which then emit sulfur dioxide and hydrogen sulfide in addition to the smoke, carbon monoxide, and the public nuisance caused. Three photographs show burning piles of coal refuse. A table shows the number of burning refuse banks by state with 213 in West Virginia, and 142 in Pennsylvania. A chart shows the sulfur dioxide and hydrogen sulfide concentrations in a community adjacent to a burning refuse pile. Controls are based on keeping air out of the piles by compaction of the refuse which has been ground to less than 2 in. size. Fires are fought by quenching with water or by use of a lime-soda slurry. The control of coal refuse piles in Pennsylvania has been placed under the Air Pollution Control Commission, which issues permits and investigates fires which might cause air pollution.

**64-0731**

Talbot, J. S., and P. Beardon. Deep well disposal has possibilities. Chemical Engineering, 9(1):72-74, Jan. 1964.

The disposal of industrial effluents by deep well disposal which has long been used in the oil and gas industry is reviewed. A detailed geological examination of the proposed area is necessary to determine the presence and extent of a vertical impermeable strata and a permeable and porous strata into which the effluent may be injected. The usual procedure is to pump the effluent under pressure which may reach as high as 3,500 lb per sq in. with the rates in the 10 to 2000 gal per minute with the usual range being 100 to 330 gal per minute. Sulfuric acid could react with a calcium chloride brine to plug the aquifer with calcium sulfate. Underground disposal offers a method of getting rid of effluents if the hazards to potable water and mineral deposits are recognized.

**64-0732**

Talbot, J. S., and P. Breardon. The deep well method of industrial waste disposal. Chemical Engineering Progress, 60(1):49-52, Jan. 1964.

The oil and gas producing industry which has used the deep well method of liquid waste disposal for years recognizes it as safe, efficient, and permanent. These factors which must be considered by prudent operators are discussed in detail: State laws concerning such disposal; general legal aspects; subterranean geology; groundwater hydrology; injection pressures and volumes; chemical and physical problems of injection; preliminary disposal well design and estimated costs; surface equipment design and estimated costs; and cost of operation.

**64-0733**

Tassoney, J. P., R. L. Albright, and E. B. Stuart. Batch process removes oil, fat, and grease. Water Works and Wastes Engineering, 1(8):38, Aug. 1964.

Successive chemical treatment and contaminant removal under continuous operator surveillance insures a high degree of treatment for a difficult to handle waste produced in the manufacture of lubricating greases and other petroleum lubes and specialty products. This will help abate pollution in the Allegheny and Ohio rivers. The Humble Oil and Refining Company, the developer of this form of waste treatment, produces wastes that are small in quantity, but complex in composition. The primary contaminants are fats, grease, and oil. Humble employs sequential accumulation, equalization, flotation, coagulation, sedimentation, and separation in single tank to handle the small-volume highly variable waste.

**64-0734**

Tenney, M. W., and W. Strumm. Chemical flocculation of microorganisms in biological waste treatment. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.518-539.

Although biological treatment of wastes is superior to chemical treatment for the removal of soluble organic matter, interest in chemical methods has been revived, particularly to process biologically treated effluents when additional purification is needed. Chemical treatment is used for the removal of phosphates. Research was conducted to investigate the extent that chemical flocculation methods can complement and partially substitute for biological treatment. The efficiency of biological treatment depends upon flocculation. The use of chemical techniques for flocculation reduces the detention time of the biological unit. The flocculation of bacteria is discussed. Factors affecting the stability of microbial dispersions include hydrogen ion, the physiological conditions of the cells, and polymers of biological origin. A high degree of control in the flocculation of microorganisms and the precipitation of phosphate can be achieved by control of pH and degree of agitation. The flocculation experiments carried out with samples from cultures are discussed. Chemical elements added for the flocculation of dispersed microorganisms have the following requirements: they should become strongly bonded to the microbial surface by chemical or electrostatic forces; and should be able to form linear polymers capable of uniting the microbial particles into a loose three-dimensional structure. Synthetic polyelectrolytes and metal coagulants are discussed. Experiments were conducted to test whether chemical flocculability, like bioflocculation, is affected by the physiological conditions of the microorganisms. The quantity of chemical flocculents necessary can be predicted from the concentration of microorganisms and the phosphate content of the solution. Chemical flocculation of microorganisms, like biological flocculation, can be interpreted in terms of a polymerbridge between the individual microbial particles.

**64-0735**

Tenney, M. W., R. H. Johnson, and J. H. Symons. Minimal solids aeration activated sludge. Paper No. 3790. Journal of the Sanitary Engineering Division, American Society of Civil Engineers, 90(SA1):23-42, Feb. 1964.

Complete mixing activated sludge systems were tested on a laboratory scale to observe their performance under high organic volumetric loadings and short solids retention times. Tabulated and graphically presented data show that the systems operated effectively under these conditions with rapid removal of soluble organic matter from solution. Extensive consideration was also given to the problem of the treatment or disposal, or both, of the large quantity of solids created in highly loaded activated sludge systems. The feasibility of using either moderate or extended solids aeration, complete mixing activated sludge, chemical treatment, or an oxidation pond, was investigated for treatment of material from the highly loaded, highly wasted complete-mixing activated sludge system. Illustrated data show that: at high primary volumetric organic loadings, a second stage complete-mixing activated sludge system with a longer solids retention time will improve the over-all soluble organic removal; aluminum sulfate coagulation was an effective means of concentrating the dispersed, minimal-solids aeration, complete-mixing activated sludge effluent; and an oxidation pond receiving such effluent was effective in treating the solids and metabolizing biodegradable soluble COD without odors or problems.

**64-0736**

Thompson, R. N., J. E. Zajic, and E. Lichti. Spectrographic analysis of air-dried sewage sludge. Journal of the Water Pollution Control Federation, 36(6):752-759, June 1964.

Tests were made from samples of thirteen different treatment plants in Oklahoma. A table is presented showing the percentages of each element present in the sludge. The ones found in major quantities, one percent and greater, were aluminum, calcium, iron, magnesium, silicon, and in one plant, vanadium. Other elements are grouped as intermediate, 0.01 to 1.00 percent, and trace, 0.001 to 0.01 percent. Spectroscopy can determine if there are sufficient quantities of toxic inorganics in sludge to be harmful to flora and fauna which aid in waste treatment processes. Several examples are given. Spectroscopy is also suggested as a method to determine if there are large enough percentages of valuable metals to warrant commercial recovery of them from the sewage sludge. Oklahoma City is used as a demonstration of this fact, showing that up to $17,000 worth of silver and large amounts of other valuable metals went into fertilizer every year.

**64-0737**

Treatment of combined municipal and industrial wastes. British Chemical Engineering, 9(2):71-72, Feb. 1964.

The combination of industrial wastes with domestic sewage in municipal sewage plants is discussed. In those cases where the industrial and municipal wastes are compatible, there are significant benefits. The unavailability and cost of land on many industrial sites is a factor favoring the discharge of industrial effluents to the sewer. It is obvious that inflammable. explosive materials, rapidly settling solids, corrosive wastes, or toxic metallic salts should be excluded from municipal sewers. There must be mutual trust and cooperation to have a successful program of joint treatment of industrial and municipal wastes. Procter and Gamble has succeeded in discharging 80 percent of the effluents from its plants into municipal sewers. It was concluded that tests conducted with the cooperation of the municipal authorities may show that factory effluents may be treated more efficiently and economically by the municipal sewage plant than by the factory treatment plant.

**64-0738**

Van Kleeck, L. W. Operation of vacuum filters. In Sludge concentration, filtration, and incineration. Continued Education Series No. 113. Ann Arbor, University of Michigan, School of Public Health, 1964. p.105-125.

The factors, other than mechanical, which affect vacuum filter operation are: (1) types of filter medium; (2) sludge characteristics; and (3) sludge conditioning. Types of filter medium include: (1) cloth media; (2) cloth media with string discharge; and (3) permanent media such as enmeshed coil springs or stainless steel woven wire belting. The characteristics of sludge are: (1) size and shape of solid particles; (2) the alkalinity of sludge water; (3) the ratio of volatile matter to ash; (4) the percent of sludge solids; (5) raw sludge versus digested sludge filtration (a table gives a comparison); (6) industrial wastes as contaminants, and (7) sludges requiring no conditioning chemicals. The conditioning of sludge is accomplished by: (1) solids concentration (not less than 5%); (2) chemicals (usually ferric chloride with or without lime); and (3) elutriation. These factors are discussed and technological details given from experience. The mechanical operation of mechanical filters is described and data presented. Maintenance and computations for control and optimum performance of vacuum filters are given. Design features for the improvement of vacuum filter operation are also listed. The future of vacuum filtration depends on research and the practical developments in this and other dewatering processes.

**64-0739**

Wahl, E. D., A. M. Cooley, and G. O. Fossum. Digestion of potato waste substances-laboratory conditions. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.291-302.

Three distinct studies are reported: (1) the determination of the rate of oxygen uptake by potato substance; (2) activated sludge treatment of potato waste media; and (3) the improvement in the digestion rate of potato waste media. The degree of release of cellular material (by grinding or cooking) has considerable effect upon the rate of oxygen uptake. The maximum rate occurs with the cooked potato. The pH, if in the range 7 to 9, has little effect upon the rate. The results of the study of activated sludge treatment are discussed. The results were so unpromising that the work was discontinued. In the third part of the study it was found that the waste material was extremely variable, and there were thus large variations in the BOD initially present. The slicer waste used did not respond well to treatment. Fortunately, this waste is settleable and can be removed mechanically from plant streams without using biological methods. Work has been partially completed on a lye peeler supernatant and a similar experimental design used on this waste.

**64-0740**

Washington, D. R., L. J. Hetling, and S. S. Roa. Long-term adaptation of activated sludge organisms to accumulated sludge mass. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.655-666.

The specific sludge system investigated was a heterogeneous extended aeration type. The first phase of the study was to determine under laboratory conditions the period and extent of adaptation of the organisms to the degradation of normally biologically-inert, volatile solids. The second phase was a study of the influence of the adapted organisms on the accumulation of sludge materials resulting from different types of organic wastes. 'Adaptation' is used in a broad sense to include physiological adaptation, mutation, and selection. The phase one results raised more questions than they answered. Were the normally biologically-inert, volatile solids metabolized by unique species of microorganisms or by common ones which underwent physiological adaptation of their enzyme system? An organism closely related to Pseudomonas fluorescens was the only bacterial species isolated on nutrient agar from activated sludge actively degrading the normally biologically-inert volatile solids. This adapted organism was able to reduce the inert sludge by about 50 percent and could be inoculated into other carbohydrate-fed activated sludge systems (it was uncertain whether it could be inoculated into other systems). Once the portion of the sludge to which the organism is adapted is metabolized, the organism apparently is unable to continue the degradation of this material as it is produced so the system returns to a sludge accumulation rate typical of equilibrium systems. It is not clear if there is long-term cyclic reduction in the accumulated volatile solids.

**64-0741**
Whaley, H. P. Waste disposal and reuse of waste water in taconite ore beneficiation operations. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.27-31.

Twenty-four million long tons of taconite are mined a year by the Erie Mining Company in Hoyt Lakes, Minnesota. An additional 13 million long tons of waste rock and surface material are hauled to dumps of the iron formation. Water is used in the grinding process, as an aid in the magnetic separation of the iron ore, to convey the products of a concentrator (both waste and the desired final product), as a motivating force in the siphon-sizers, as a dust collector, as a coolant for the lubricants and parts of the furnace, and in many other ways. About 11 tons of water are required for every ton of crude ore processed. At this plant this amounts to 120,000 gal per minute or 720,000 tons of water per day. The geographic features and the regulations of the State of Minnesota make it necessary that a minimum of 108,000 gal per minute be reclaimed since only 12,000 gal per min can be taken from a reservoir. Water is reclaimed by the use of tailing thickeners overflow and water from the tailing basin. Four tailing thickeners with a retention time of 3.5 hr and 0.5 ton per day cautisized corn starch are used. Cautisized starch has proved to be an effective and economical flocculent. The requirements for the flocculent are: (1) to provide an overflow with no more than 300 ppm total solids; (2) to have no harmful effect on any part of the process; (3) to be easy to feed and handle; (4) to cost the least per ton of material treated, from the tailings thickener 70 percent of the water is recovered (94,000 gal per min). The tailing basin complex covers 1700 acres in the first, 800 acres in the second, and 200 acres in an emergency basin. The factors controlling clarification are area of water surface, depth, temperature, ice coverage, wave action, pH of basin water, and minerals in the tailings. A floating pump house (a barge 60 ft x 80 ft with five pumps with a total capacity of 35,000 gpm) is located near the center of the basin and normally reclaims 20,000 gal per min. The pump's suctions are in sectional pumps equipped with adjustable weirs to skim off only the surface water. Fifteen million tons of tailings are deposited on the disposal area annually. Water is used as the medium for transport through pipelines. This water is very dirty after contact with the ore and must be clarified before reuse. The disposal system is closed; the only water loss is from evaporation, water driven in the agglomerating operation, seepage at a reservoir, and water entrapped with the tailings themselves. The steps being taken to grow plants on the dams are also described.

**64-0742**
What to watch for in sludge-cake storage. American City, 79(2):35, Feb. 1964.

A specially designed storage bin, which stores sewage sludge dewatered on vacuum filters, is used by San Francisco's Department of Public Works. The sludge can be transferred conveniently from the storage bin to sanitary fills for disposal. The storage bin was designed to receive 100 tons of sludge from a conveyor belt able to deliver 7½ tons an hr. To provide positive control at the discharge portion of the bin, the designers provided eight horizontal shear gates, 4 x 8 ft in size. Each gate serves a quarter of the storage bin. The gates are operated hydraulically from controls located on the side of the bin. They open and close at a speed of approximately one-tenth of a ft per sec. Eighty tons of sludge a day for 5 days a week can be moved by the unit, which cost $50,000. The use of vacuum filter drying, rather than dewatering in flash driers, has produced a savings of $42,000 annually.

**64-0743**
Williamson, J. N., A. H. Heit, and C. Calmon. Evaluation of various adsorbents and coagulants for waste-water renovation. AWTR-12. U.S. Department of Health, Education, and Welfare, June 1964. 91 p.

Minerals, industrial by-products, proteinaceous materials, and conventional water treatment agents were among the commercially available materials tested for the treatment of waste waters. Activated carbon was used as a reference. Minerals treated with salts of tetravalent metals, most conventional coagulants, and proteins coagulated in the presence of mineral acids exhibit affinities for the organic-solute phase of secondary waste-water effluents. Hydrophobic proteins and organic anion exchangers will also remove organic solutes from waste water. The problem of irreversible organic fouling requires more attention if exchangers are to be considered in advanced waste treatment. Precoagulation of the higher molecular species of organics is suggested as a fouling preventive measure. This study demonstrated the feasibility, at least from a mechanical standpoint, of incorporating solid adsorbents into the sludge blanket process for water treatment in the presence or absence of coagulants. The sludge blanket process can combine the virtues of the finely-divided, large-surface-area forms of solids and flocs (normally associated with batch treatment techniques or vacuum filtrations) with the maintenance of relatively high flow rates, normally associated with columnar-bed techniques. Material cost factors are discussed for various materials tested and for the treatments involving their use. Explanatory figures and tables are included.

**64-0744**
Woods, C. E., and J. F. Molina. Glycine uptake by anaerobic waste water sludge. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.1011-1024.

Proteins occupy a central position in the structure and function of living matter. About 70 percent of the organic material in living cells is protein while the protein content in domestic waste water sludge is 30 to 50 percent. Proteins are polymers of amino acids and the hydrolysis of amino acids results in a mixture of amino acids and ammonia. Amino acids satisfy the requirements of microorganisms for nitrogen, carbon, and energy. The primary objectives of the present study were to estimate the extent and rate of hydrolysis of proteins in the anaerobic treatment of sludges, to estimate the uptake rate of glycine by the heterogeneous microbial population, to differentiate between the biological uptake and the nonbiological uptake, and to evaluate the effects of glycine concentration on glycine uptake. The equipment and procedures used are described. The physical and chemical characteristics of the sludges from anaerobic digestion systems are given in a table. The glycine-1-carbon fourteen uptake versus time is shown in a figure. It was found that about 38 percent of the proteins were hydrolyzed during the first stage of digestion. However, the concentration of free amino acids decreased during the first stage of digestion which indicates that they were taken up at a slightly higher rate than the rate of protein hydrolysis, namely between 0.07 and 0.13 mg per liter per minute. The results of uptake studies using carbon fourteen tagged glycine indicate a rate of about 0.026 mg per liter per minute for sludge in the first stage of digestion. The uptake of glycine consists of a rapid nonbiological uptake completed in about 2 minutes following by a biological uptake of about 10 mins after which there is no appreciable uptake. The rate of glycine uptake is affected by both the temperature at which the sludge was incubated and the condition of the sludge.

**64-0745**
Wulf, H. The incineration of sludges with oil vaporizing burners. Brennstoff-Waerme-kraft, 16(8):397-399, Aug. 1964.

Industrial sludges can be incinerated very economically by means of 'Ghelfi' oil vaporizing burners. These burners consist of three coaxial tubes. One carries the oil, one the steam for vaporization of the oil, and the innermost carries the sludge. Liquid industrial waste with a water content as high as 97 percent can be burned. High combustion temperatures ensure that non-combustible material is molten and then granulated. The flue gas is therefore free of dust. Two examples for sludge incinerators are described briefly, one with, and one without utilizing the heat of combustion. (Text-German)

## HAZARDOUS WASTES (including Radioactive and Pesticides)

**64-0746**
Davies, A. G. Disposal of radio-active wastes. Public Cleansing, 54(3):773, Mar. 1964.

Methods of disposal of radioactive waste are surveyed. The activity level of some wastes is reduced by a chemical process. The strongest possible precautions are exercised in disposing of radioactive solids wastes in sea, river, and sewers. The chief problem for local authorities is the disposal of such wastes by small users. In Great Britain some use has been made of abandoned mine shafts. The establishment of a British national disposal service for radioactive wastes is recommended. Most radioactive isotopes can be disposed of by incineration without risking contamination of the atmosphere. A Canadian study on the effects of radiation is reported.

**64-0747**
Faust, S. D. Pollution of the water environment by organic pesticides. Clinical Pharmacology and Therapeutics, 5(6):677-686, 1964.

Pesticides and their formulations impart off-tastes and off-odors to drinking water at very low concentrations. These substances enter ground and surface water through direct application for control of aquatic weeds, trash fish, aquatic insects, percolation and runoff from agricultural lands, drift from aerial and land applications, and discharge of industrial and cleanup waste waters. A comprehensive study of the distribution of toxaphene, 0.05 mg per liter, a pesticide is reported. Esters of 2,4-D (Dichlorophenoxyacetic acid) are used for aquatic plant control in reservoirs for drinking water supplies. Data suggests the use of ultraviolet irridation for oxidation of dichlorophenol at potable water treatment plants but usage is insignificant in decomposition of 2,4-D. Organic pesticides found in the water environment in concentrations less than 5.0 mg per liter have toxic effects on aquatic life and are concentrated by food chain organisms into fish or shellfish. Trace amounts may not have been present long enough or in sufficient concentrations to gather epidemiological evidence. Since the concentrations of several organic thiophosphates and 2,4-D producing tastes and odors are far below subtoxic levels by factors ranging from 17 to 113,000, threshold taste and odor levels can be used to establish drinking water standards with the appropriate safety factors. Data on distribution residues and treatment is given.

**64-0748**
Henderson, C. B., K. D. Johnson, K. E. Rumbel, et al. Standard operating procedures for safe handling of beryllium. Edwards AFB, Calif., Air Force Flight Test Center, 1962. 26 p.

Waste disposal of beryllium is discussed in this study. Beryllium-containing gases require an adequate dust collection system. Wet scrubbing, dry filtration, and electrostatic precipitation have been satisfactory. Discharge of beryllium-containing liquid waste should comply with applicable local ground-water stream pollution control ordinances. Beryllium contaminated combustible wastes should be kept segregated from non-contaminated wastes. The degree of classification of such wastes will depend upon the method of disposal. Combustible contaminated beryllium wastes should be burned periodically so as to preclude excessive accumulation. Non-combustible contaminated beryllium wastes may be buried in a suitable burial pit or at sea. (Defense Documentation Center for Scientific and Technical Information. Unclassified AD 461288) Furnished under contract by Atlantic Research Corp., Alexandria, Va.

**64-0749**
Meyer, K. P. Evolution of the problems of occupational diseases acquired from animals. Industrial Medicine and Surgery, 33(5):286-296, May 1964.

In the United States there are 23 infections that man can contract from animals primarily in the course of his occupation. Anthrax is an occupational infection of shepherds, farmers, butchers, skinners, and tanners, and veterinarians. The most frequent mode of infection of herbiovores is food or insect bites. Industrial anthrax is caused by inhalation of spore-bearing dust from infected wool, and plagues the goat hair industry in the United States. Brucellosis, or undulant fever can be contracted through drinking raw infected milk, or through contact with an infected cow and calf at the time of abortion. In recent tabulations, packing house workers had the highest incidence of undulant fever. The ability of the parasite to infect through nearly any tissues makes prevention difficult. Leptospirosis is associated with occupational exposures among veterinarians, abattoir and sewer workers, dog breeders, and gardeners. Infection in man is accidental, and usually represents the end in the chain of transmission. The key to the spread is the widespread excretion of leptospires in the urine of the carrier animals. A group of occupational infections were traced to unsanitary poultry processing houses heavily infested by rats. Spread of the disease can be suppressed by trapping or poisoning rats in sewers. Extent of occupational diseases from animals should be determined, as well as the source and modes of transmission. Steps for prevention and control must be taken.

**64-0750**
Michaelsen, G. S. Waste handling. In Proceedings; National Conference Institutionally Acquired Infections, Minneapolis, Sept. 4-6, 1963. Atlanta, U.S. Public Health Service, 1964. p.65-69.

Solid wastes in hospitals are divided into reusable items and disposable items. In the area of disposable solid waste, the combustible trash constitutes the greatest volume as well as a highly suspected waste, which accumulates in the hospital. As a part of a study of solid waste problems, 3,186 items of 42 different kinds were found in 104 waste baskets. The potential for spread of contamination by handling this type of waste becomes serious when it is considered that the wastes are laundry hampers, carts, buckets; that some is wrapped and some is loose; some of it is wet or bloody; and some of it is stored in patients' rooms, in utility areas, in trash chutes, and in incinerator rooms. The potential hazard of handling combustible trash can be greatly reduced by using liners in all receptacles. These should be tied or stapled shut when full and transported to the point of disposal. During periods of severe overloading of incinerators, unburned or incompletely burned infectious material may escape from the incinerator stack. If the stack is close to a fresh air intake, it is then possible for infectious material to be brought back into the hospital. Non-combustible trash such as the metal parts of disposable plastic devices, plaster casts and food tins, can be buried on a trash dump or a sanitary landfill.

**64-0751**
Now, refrigeration for radioactive sludge! Modern Refrigeration, 67(798):898, Sept. 1964.

A new experimental refrigeration machine to concentrate radioactive sludge by freezing and controlled melting is described. The unit consists of a low carbon steel tank, a brine handling set, and electric reheat system. Brine, the heat transfer media, is circulated through vertical, stainless steel seat exchanger plates located in the tank. The brine is refrigerated by a R-22 condensing set, which includes a semihermetic Worthington 7.5 hp compressor, a water cooled condenser, and electric heater. The cycle of freezing and melting is automatically controlled by a clock-driven programmer. The tank is equipped with a slanting bottom and a gauge to check the sludge level. Valves are located at different tank levels to drain off non-radioactive sludge before reaching the radioactive parts.

**64-0752**
Paul, R. C. Crush, flatten, burn, or grind? The not-so-simple matter of disposal. Hospitals, 38(23):99-101, 104-105, Dec. 1, 1964.

In consideration of the relative merits of disposable versus reusables for hospital use, the problem of disposing of the disposables is often neglected. In a change-over to the volume use of disposable items, it is important that the plant engineer, the executive housekeeper, and the laundry manager work closely with nursing and purchasing to plan for changes in procedures and equipment. A picture is given of a disposal unit at the Baylor University Medical Center which crushes and flattens cans and bottles to reduce the volume of waste and permit more waste to be removed with each truck trip. A hydraulic packer is shown which compresses 100 cu yd of loose trash into 24 cu yd before incineration. A syringe crusher is shown which breaks disposable syringes so that they cannot be used in an unauthorized manner. It was found that when paper towels were supplied to each patient's room, an additional waste basket was required, the maintenance costs from plugged toilets increased, the labor charge for emptying and washing wastebaskets increased by 30 percent, but the volume of cloth towels did not decrease. Housekeeping departments have had to increase their trash handling facilities and personnel to keep up with the ever increasing amount of trash such as paper cups, pitchers, washcloths, bath mats, caps, towels, preoperative sets, etc. The incinerator load per patient per day has increased from 8 lb to 10 lb in the last few years. Pathological material should be burned in a separate unit for this purpose. The method of handling and ultimate disposal of disposable items should be planned in advance of their use.

**64-0753**
Pesticide residue problems probed. Chemical and Engineering News, 42(16):32-33, Apr. 20, 1964.

Endrin, a widely used pesticide, is the most likely cause of the massive fish kills which occurred in the lower Mississippi River late in 1963. The U.S. Public Health Service report on the incidents touched off investigations by the Senate Subcommittee on Reorganization and the Department of Agriculture. During the Senate hearing several facts were brought out. Residues of endrin and dieldrin have been found in the drinking water of New Orleans and in the waters of the lower Mississippi. The U.S. Public Health Service has started an investigation of all major U.S. river basins to determine the presence of the pesticides. Suggestions were made to ban these pesticides from agricultural use. There was speculation that spills from pesticides producing or repackaging plants were the source of pollution. Endrin was found to be the cause of the fish deaths. Representatives from two major chemical companies manufacturing the pesticides contested the results from the U.S. Public Health Service research. In conclusion, one of the representatives presented reports from a fish kill in 1960. In this one, the symptoms were similar, but the killing agent was a bacteria, Aeromonas liquefaciens.

**64-0754**
The President's Science Advisory Committee.
Use of pesticides. Washington, The White House, May 15, 1963. 25 p.

Information relevant to pesticides was reviewed, including experimental data and the various administrative procedures which are designed for the protection of the public. The material standard of living has been greatly elevated during the 20th century by increased control of the environment and pesticides have made a great impact by facilitating the production and protection of food, feed, and fiber. Although pesticides remain in small quantities, their variety, toxicity, and persistence are affecting biological systems in nature and may eventually affect human health. Four classes of pesticides are described. The land area treated with pesticides is approximately 1 acre of 12 within the 48 states and about 45 million lb are used each year. Methods of pest control without chemicals are examined and the conclusion is reached that more active exploration of these techniques may yield important benefits. The role of government agencies in pesticide regulation is discussed. Recommendations are directed to an assessment of the levels of pesticides; to measures which will augment the safety of present practices; to needed research and the development of safer and more specific methods of pest control; to suggested amendments or public laws governing the use of pesticides; and to public education.

**64-0755**
Radiological Pollution Activities Unit.
Process and waste characteristics at selected uranium mills. Cincinnati, Robert A. Taft Sanitary Engineering Center, U.S. Public Health Service, 1962. 93 p.

The findings of detailed studies of process and waste flows at five typical uranium mills are reported. The studies were initiated in 1957 by the Public Health Service for the purpose of characterizing the liquid and solid wastes resulting from uranium milling processes, particularly radioactive wastes arising from the extraction of uranium from its ores. Specific objectives of the studies include detailed analysis of the extraction process, characterization of the resulting liquid wastes, evaluation of their water pollution and public health significance, and development of adequate and suitable waste control measures. The processes investigated are: the resin-in-pulp uranium extraction process; the acid leach-solvent extraction uranium refining process; and the carbonate leach uranium extraction process. The five mills typified the processes normally encountered, i.e., acid or alkaline leaching of the ore, concentration and purification of the leach liquor by ion exchange of solvent extraction, and chemical precipitation of the dissolved uranium. Although the radioactive materials, especially Radium 226, were of primary interest in these studies. Useful information regarding the chemical characteristics of milling wastes was also obtained.

**64-0756**
Safe disposal of empty pesticides containers and surplus pesticides. Washington, Agricultural Research Service U.S. Department of Agriculture, 1964. 6 p.

A guide is presented with recommendations for farmers, commercial pesticide applicators, city, state, and federal pest control officials, and others who use large quantities of pesticides. Pesticides and containers should be kept in a separate building or room or in an enclosure. Weedkillers, herbicides or defoliants should not be stored in the same room with insecticides. Volatile materials such as 2,4-D and its derivatives can contaminate other pesticides. Chlorate salts can create a fire or explosion hazard. A procedure for the disposal of pesticide containers is outlined. Containers which have held weedkillers such as 2,4-D and its derivatives should not be burned. These containers are disposed of by breaking the glass containers and chopping holes in metal containers. All weedkiller containers must be buried to a depth of 18 in. at a safe disposal site or taken to a dump where they will be covered with soil. If burning is not possible, a thorough rinsing procedure will eliminate much of the pesticide residue and hazard. Surplus pesticides should not be taken to a public dump or incinerator. Left over spray mixture should be poured into a pit dug in sandy soil.

**64-0757**
Solidification process looks at long-term nuclear-waste storage. Chemical Engineer, 71(24):74, Nov. 23, 1964.

General Electric Company has developed a continuous phosphate-glass solidification process for long-term storage of nuclear wastes. The process concentrates the waste into a congealed solid, which is stored in a vessel.

**64-0758**
Straub, C. P. Low-level radioactive wastes; treatment, handling disposal. Washington, U.S. Atomic Energy Commission, 1964. 430 p.

Techniques of handling, treatment, and disposal of low-level wastes which arise in all nuclear energy operations are described. Guides to radiation-exposure assessment are given. Topics covered are: sources, quantities, and composition of radioactive wastes; collection, sampling, and measurement of gaseous, and solid wastes; discharge to the water, soil, and air environments; removal of radioactivity by water treatment processes; treatment of radioactive material by biological processes; on-site treatment; handling and treatment of solid wastes; and public health implications. Standards for protection against radiation and site selection criteria are appended. Specific examples of packaging and treatment of wastes and their disposal on land and in the ocean are described in some detail.

**64-0759**
Straub, C. P. Handling and treatment of solid wastes. Solid wastes. Quantities of waste produced. In Low-level radioactive wastes; treatment, handling, disposal. Washington, U.S. Atomic Energy Commission, 1964. p.313-314.

Solid wastes originate in all operations of the nuclear energy industry. They may occur from direct operations, for example, as contaminated paper, laboratory glassware, and equipment, or they may be the end products of other operations, as for example, chemical slurries and sludges, evaporation solids, and ion-exchange resins. Combustible wastes include air filters; paper; wood; clothing; and biological materials such as human and animal excreta, autopsy specimens, laboratory animals, and vegetation. Contaminated laboratory and process equipment that cannot be decontaminated satisfactorily, such as glassware, pipes, pumps, concrete, sludges from chemical precipitation plants, evaporator bottoms, incinerator ash, and ion-exchange resins, are included in the category of noncombustible wastes. If the objects are small, they may be packaged before disposal; if large, they may be disposed of without packaging. The small isotope user or hospital may produce a few cu ft of waste, while a national laboratory may generate hundreds of thousands of cu ft of solid wastes annually. Waste production figures are summarized and data from British sources are given.

**64-0760**
Straub, C. P. Handling and treatment of solid wastes. Collection, sampling, and measurement. In Low-level radioactive wastes; treatment, handling, disposal. Washington, U.S. Atomic Energy Commission, 1964. p.314-318.

Containers used for the collection of low-level radioactive solid wastes range from fiber drums, cardboard boxes to 55-gal steel garbage cans or drums, usually lined with polyethylene, waterproof paper, or chemically treated paper bags. In some installations, collections follow notification that the waste container has been filled or that established permissible exposure levels have been reached. Several laboratories utilize steel Dempster-Dumpster bins and trucks for the collection of filled waste containers and for their transport to the on-site disposal area. Protective clothing is used by personnel in sorting and packaging operations. Where an inhalation hazard exists, the workers also wear protective respirators or filter type assault masks. In the case of shipment for off-site disposal, great care is taken in packaging. Steel drums are used for slurries, sludges, and loose bulky materials; the wooden and concrete boxes for trash and miscellaneous items. Containers are generally marked to indicate date, levels of activity, and nature of the materials. For off-site shipment, packaged wastes are usually loaded into AEC-owned trucks or are shipped by common carrier. U.S. Navy crews normally load materials when Navy facilities are used for sea disposal.

**64-0761**
Straub, C. P. Handling and treatment of solid wastes. Waste handling. In Low-level radioactive wastes; treatment handling, disposal. Washington, U.S. Atomic Energy Commission, 1964. p.318-325.

Before disposal either on land or into the ocean, the combustible or compressible wastes can be concentrated by baling or by incineration. Three laboratories are cited as baling wastes, using hydraulic baling machines or a hand-operated baler. A typical layout for a waste incinerator is illustrated. It consists of a sorting chamber, an air intake, the incinerator itself, and ash hoppers. A fly-ash settler, an adiabtic cooler, a Venturi scrubber, a cyclone-water scrubber, a gas heater, and filters are used to cleanse the flue gases before they are released through the stack. Experience has shown that approximately 95 percent of the activity is retained in the ash, about 4.5 percent is removed by the scrubbing systems, and about 0.5 percent is handled by the filters. Five land disposal sites in the United States have been designated for the receipt and burial of packaged radioactive wastes. Different procedures are used for the burial of alpha and beta contaminated wastes. Accurate records are kept of the material placed into the trenches and their locations should be marked on plot maps. Materials for disposal into the ocean are packaged in drums with sufficient concrete added to cause the drums to sink. The containers are transported to barges and the barge is towed 600 miles out to sea.

**64-0762**
Straub, C. P. Handling and treatment of solid wastes. Waste handling. In Low-level radioactive wastes; treatment, handling, disposal. Washington, U.S. Atomic Energy Commission, 1964. p.325-326.

Data show that the cost per cu ft of waste collected for on-site burial ranged from $0.77 to $0.90; shipment for land disposal, from $1.45 to $3.38; shipment for ocean disposal, from $0.97 to $5.78. Maintenance costs for an institutional incinerator amounted to less than $1 per month over a period of almost two years of operation during which 3,400 lb of assorted combustibles were processed. The cost of incineration at one laboratory amounted to $2.68 per cu ft for 8 hr and $1.60 per cu ft for 24-hr operation schedules, as compared with solid storage costs of $9 per cu ft.

**64-0763**
Tsivoglou, E. C., and R. L. O'Connell. Waste guide for the uranium milling industry. Technical Report W62-12. Cincinnati, U.S. Public Health Service, 1962. 78 p.

The guide is intended for the use of public health and water pollution control agencies, mill operators, and others in their efforts: (1) to evaluate the potential hazards associated with mill wastes; (2) to determine the effectiveness of existing mill waste control practices; (3) to estimate the effect of future mills on their local stream environment and locate mill sites so as to minimize such adverse effects; and (4) to find more effective methods of waste control and treatment. Various phases of mill processes, process waste, pollution effects of waste, and pollution abatement methods are discussed and presented. The uranium milling industry is a major source of radiological pollution of the acquatic environment. It is only by employing the most careful and deliberate waste control measures that this potential threat can be prevented from becoming an actuality. Chemical and radiological pollution of ground waters by uranium mill wastes has been shown to occur. The extremely long half-life of the major radioisotope involved (radium-226), whose half-life is 1,620 years, means that permanent control of ore residues is required. Acceptable methods of very long-term storage and retention need to be found.

**64-0764**
Walter, C. W. Disposables, now and tomorrow: for the surgeon, many advantages, but still some problems. Hospitals, 38(23):69, 70, 72, Dec. 1, 1964.

The advantages and disadvantages of using disposable supplies in the hospital are reviewed with emphasis on the intangibles. The disposable supplies are a benefit and convenience in the care of the patient and have the advantage of standardization. One of the main intangibles is faulty technique which may result in the sterile items becoming contaminated in use or in preparation for use. Getting rid of used disposables presents a problem because of bulk. Discarded needles and cutting edges are an occupational hazard to personnel. The combing of the dumping area by children for items of interest for play and various attempts to salvage materials and devices show that trauma and the spread of infectious disease are real hazards in the disposal of disposables. The safe disposal begins with the user who first discards the disposable. Infectious and radioactive materials and unused drugs must be discarded in containers for special processing. Cannulated needles must be broken and cutting edges protected and these items should be collected in containers that can be transported as are. The ultimate disposition by prompt incineration or by destruction and burial is the responsibility of the hospital. Lint from the careless disposal of paper and nonwoven products results in a serious problem. Following disintegration in washers, the short fibers coat the textiles and are thus spread throughout the hospital. Dressings and paper should be kept out of soiled linen. The successful use of disposables requires comprehensive and thorough training of personnel.

**64-0765**

Weeren, H. O. Pipe radioactive wastes to shale beds. Conventional components comprise a unique system. Heating, Piping, and Air Conditioning, 36(11):122-123, Nov. 1964.

A study of Oak Ridge National Laboratory on the piping and injection of radioactive wastes into shale beds is described. Several 40,000 gal batches of intermediate level waste solution, mixed with cement and other additives, were injected into a shale formation at a depth of about 900 ft. Each injection sets up a thin, roughly horizontal grout sheet several hundred feet across. The equipment used consists of a waste transfer pump and spare, four bulk storage tanks for the cement and other additives, a jet mixer, a surge tank, a high pressure injection pump, a stand-by injection pump and mixer, and assorted valving and special equipment. Some of the equipment is installed in cells to reduce the radiation exposure to operators and to limit the area that would become contaminated in case of a leak. The two phases involved in each waste injection are described and at the end of the second phase a plug of cement is pumped down the injection well and allowed to set to seal the injection. Other steps in the process prior to injection are described, such as transferring the waste solution from the laboratory system to the waste storage tanks by piping and the mixing of the radioactive waste with cement.

**64-0766**

Wilcox, F. W. The role of government and private enterprise in radioactive waste disposal. Frankfort, Kentucky Department of Health, 1964. 12 p.

Source and quantity of radioactive waste, waste management, sea burial, return to the AEC, incineration, release to the environment, land burial, regulatory authority, special problems, and land burial site selection are discussed. Charts and summary furnished. Numerous geological and hydrological investigations must be performed before any land burial site can be authorized. This investigation can get extremely involved as the following agencies must be contracted for guidance and assistance before any final decisions can be reached: Atomic Energy Commission, U.S. Public Health Service, U.S. Geological Survey, Pollution Control Commission, and numerous state governmental agencies. Contrary to popular opinion radioactive waste disposal is not big business. The largest company in this field at present, with three separate facilities in three states, employs fewer than twenty persons. Liquid wastes continue to present a significant problem to the industry even though 15 years of experience with tank retention of high level slurries indicates that this type of storage is safe as an interim measure but conversion to solids is an ultimate necessity.

## SALVAGING

**64-0767**

Abubacker, K. M., C. T. Mehta, and N. S. Krishnan. Recovery of pure germanium dioxide from germanium waste. Research and Industry, 9(6):166-168, June 1964.

A procedure is given for recovering transistor grade germanium from wastes containing impurities such as indium, gallium, and tin. Since there are no mineral deposits of germanium in India, the recovery of this high-cost material is important. A flow sheet is given covering the recovery of germanium based on a combination of chemical and metallurgical methods. It must be born in mind that the reagents must be repeatedly distilled in quartz assembly in the last stages of the purification to eliminate impurities. The germanium dioxide which was obtained from the hydrolysis of germanium chloride is filtered, washed, dried, and ignited at 1000 C. This germanium dioxide is heated in pure graphite boats in a current of pure hydrogen or ammonia at 600 to 650 C for reduction to germanium which is then fused for 30 minutes at 1000 to 1100 C and cooled in a stream of pure nitrogen. The last impurities are removed by zone-melting under vacuum or in an inert atmosphere to obtain transistor-grade germanium. The whole process of recovery is one requiring careful control. For example, in the washing with acetone and ashing below 650 C to destroy organic matter, the temperature is critical, since germanium oxide sublimes at 710 C. A highly sophisticated, sensitive procedure is described for the recovery of transistor-grade germanium from wastes containing impurities such as silicon, aluminum, iron, copper, nickel, antimony, arsenic, boron, and indium.

**64-0768**
Boris, H. No 'bounce' in waste rubber. Waste Trade World, 105(20):52, Nov. 14, 1964.

The various aspects and problems of the waste rubber industry are reviewed for 1964 with special note being made of the deterioration of the market for scrap tires. The waste rubber industry is changing, and the firms both large and small that have gone out of business because of the low returns are not being replaced. Some of the firms are diversifying by going into plastics to keep going. The waste rubber industry has a problem in common with all segments of the waste and reclamation industry--that of finding suitable premises for storage that will meet with the approval of the local authorities. The use of synthetic material has reduced the demand for rubber waste. The rubber waste exports in 1962 were 27,398 tons worth £933,390; in 1963 the tonnage was 25,885 valued at £817,273, while for the first 6 months of 1964 the exports were 12,725 tons worth £452,870. Scrap tires are a glut on the market with no encouragement for merchants to collect or handle them since the prices offered by the reclaimers are much too low. Scrap tires are piling up all over the country and are not being collected. The merchants are selling their stocks at uneconomic prices and not replenishing their stock as it is depleted, and the reclaimers are being supplied only on a hand-to-mouth basis. The demand for high grade tire casings is good and the remolders are working at capacity with plenty of casings available. Foreign markets are good for quality tire casing of the right size. The export market appears to be better than the domestic.

**64-0769**
Bottenfield, W., and N. C. Burbank. Putting industrial waste to work; Mead's new lime kiln recovers waste lime mud. Industrial Water and Wastes, 9(1):18-21, Jan.-Feb. 1964.

Until recently, lime mud, left from the kraft process of wood pulp at Mead Corporation, Chillicothe, Ohio, was dumped as waste. A lime recovery system, centered around a Traylor rotary kiln, cost $1.4 million. Coincident with construction of a new causticicizing operation, it will permit the plant to increase its pulp production to 500 tons daily. The 300-ft-long rotary kiln, operating on a 24-hr-per-day, 7-day-per-week basis, produces 160 tons of quicklime daily--Mead's current requirement. This represents a raw materials saving of $1600. Recovery rate is over 97 percent. Lime mud from the clarifier is drawn from the bottom and concentrated to 40 percent solids. The kiln is driven by a 100 hp electric motor through a gear reducer at 0.75 rpm. Conversion of lime mud to calcium takes place at temperatures above 1650 F.

**64-0770**
Bovier, R. M. New system eliminates fly ash, salvages sulfur from flue gases. Modern Power and Engineering, 58(5):86-89, 140, 142, May 1964.

Development of a sulfur-smoke removal system for eliminating essentially all solids and most sulfur fumes discharged into the atmosphere while burning high ash, high sulfur-content bituminous coal in power plant boilers is described. One of the most promising dry methods known was the process whereby sulfur dioxide is removed from flue gas by oxidation to the trioxide with condensation as sulfuric acid, which if produced in acceptable quality and sufficient quantity could be used commercially. In 1961 a pilot plant was set up in conjunction with Boiler No. 15 at Pennsylvania Electric Co.'s Seward Station in order to test whether this method was operationally and economically feasible. A flow diagram and photographs are given which illustrate in detail the process as put into operation at the plant. After leaving the boiler, the flue gas passes through a mechanical dust collector and then through a high temperature electrostatic precipitator, where virtually all of the fly ash is removed. Other steps in the process include a converter, a rotary air preheater, and an electrostatic acid mist collector. Pilot plant test results indicated that 90 percent of the sulfur in the coal could be recoverable at a concentration of about 70 percent sulfuric acid. In a 1,000,000 kw station with a 90 percent load factor, it was estimated that about 750 tons of 100 percent equivalent concentrated acid would be recovered in a 24 hr day. Fixed charges and operating costs were estimated at about $7 per ton of acid. The pilot plant thus demonstrated economic and operational feasibility of the system.

**64-0771**
Brown, C. Research pays dividends. (1). Waste Trade World, 105(8):9, 12, Aug. 22, 1964.

The waste trade would do well to investigate the possibilities of expanding its markets through research. Some trades and industries invest large amounts of money on research to make certain they have a supply of new ideas and new methods, while others spend little, trusting in traditional methods. No industrialist can close his mind to what is going on around him or to future needs if he wants to stay in business. A great deal of research is down to earth and far from the glamor of space exploration, nuclear energy, and aircraft manufacture. Bread and butter projects involve the development of new methods for increasing output or cutting costs, new materials for old, new ways of using old materials, and new answers to everyday problems. Research is making steel castings stronger, glass more durable and versatile, and furniture more functional. Factories are becoming more pleasant places to work. The industry that is involved in research can extend its markets. It is time for the waste trade to become research-minded and reap the benefits.

**64-0772**
Brown, C. Research pays dividends. (2). Waste Trade World, 105(9):11, 14, Aug. 29, 1964.

Practical uses of the wastes which have resulted from research are given. A search for a use for sugar, in case it became a waste by overproduction, found that it could be made into a detergent. It was discovered that a durable, goodlooking cloth could be made from pineapple leaves and that rice husks could be mixed with cement to make building blocks. One of the outstanding accomplishments in research was the discovery that the 5 million tons of groundnut shells which were of little use as fertilizer or fuel could be made into a chipboard with a resin binder. The manufacture of the chipboard, which is suitable for partition walls and ceilings, can give a local industry built on waste, which is important in places such as India. In order for 'dirt cheap' wastes to be useful, they must be used in local industry since in most cases waste is not worth shifting because the transport costs are usually too high. In the field of waste disposal and in all other fields, the results of research do not earn their way unless action is taken by potential users. Many brilliant discoveries are not utilized quickly in industry because of the sheer inertia of management. Since investing in research means spending money, the results have to be demonstrable.

**64-0773**
Chipper. Electrical World, 162:116, Oct. 5, 1964.

The Snowmobile-Fitchburg chipper unit, an eight-wheeled Muskeg Carrier vehicle which converts wood that is up to 7 in. in diameter into chips, is described. The chipper handles with ease all cuttings, including branches, limbs, and brush which can be chipped into mulch and blown out the chute. It travels over snow, mud, or swampland with ease, but is used the year around rather than strictly in foul weather. It has proven as versatile as it is maneuverable on a number of clearing and brush-maintenance jobs. The equipment is available from F. A. Bartlett Tree Expert Co., 1770 Summer Street, Stanford, Connecticut.

**64-0774**
Closed circuit mill. Factory, 122(6):162, June 1964.

The idea of replacing ground-up sand with ground-up waste to make silica flour, a basic cement ingredient, is expressed. Using a vibrating ball mill, the company greatly reduced cost as no separation is needed, even for fine grade cement.

**64-0775**
Cross, B. Hydrolysis process makes molasses from wood. Chemical Engineering, 71:40, 42, Aug. 3, 1964.

The 500,000 gal per day of wash water from the first stage of hardboard plant containing 5 percent dissolved and colloidal solids (including simple sugars and polysaccharides) is used as a source of molasses acceptable as a livestock-feed. In this process, the conversion of wood cellulose to sugars depends on high-pressure steam treatment of wood fibers. The by-product wash liquor from the hardboard plant is concentrated from 5 percent solids to 45 percent in a battery of spray dryers in which the droplets fall against a stream of exhaust gases from a gas-turbine generating plant. The liquor is further concentrated to 55 percent solids in a vertical-tube, falling-film separator. The 50,000 gal per day molasses is neutralized from pH 3 to pH 6 to 6.5 with lime slurry. The molasses produced (called Masonex) costs $20.00 per ton compared to $31 for cane molasses. The Masonex has both pentose and hexose sugars which were formed when the wood fibers were blown with steam in the manufacture of the hardboard. The molasses has a potential market as a chemical raw material as well as its established use as a livestock feed. Photographs show the digestion of the wood chips with steam, the falling-film evaporator, and the washing of the milled pulp to obtain the wash liquor that is evaporated to obtain the molasses. The production of molasses suitable for livestock feed from wood-pulp wash waters is a profitable sideline for a Mississippi hardboard plant.

**64-0776**
Dewberry, E. B. How shrimps are canned at a New Orleans factory. Food Manufacture, 39:35-39, July 1964.

The processing operations at the New Orleans plant of the largest independent producer of canned shrimps in the world are described. A waste separator or scrubber, which has rubber rollers, is finely adjusted to remove all loose waste materials from the meats. All waste from machines is collected, dehydrated and ground into meal. Analysis shows that it contains 32 to 35 percent protein, 8.9 percent nitrogen and 10 percent ammonia. The meal is sold for stock feed or is used in the manufacture of fertilizers.

**64-0777**
Duct system handles scrap paper. Factory, 122(7):140, July 1964.

An automatic duct system handling scrap paper cuts costs 50 percent and increases disposal to 1,000 lb per hr. Pneumatic ducts suck scrap from trimmers through flange-connected piping to a material exhauster. It blows the scrap up to roof piping and over to a separator. Here air is removed from the paper as it falls down a feed chute into a baler. When the scrap builds up to the height of a photoelectric cell in the chute, a hydraulic ram automatically compresses it to bale length. An operator ties off the bale, and it is weighed and shipped.

**64-0778**
Dumping more scrap. Factory, 122(7):142, July 1964.

Self-dumping hoppers handling 35 percent more scrap are used to replace open-topped metal boxes for collecting and moving shavings and reject from lathe, hobbing, and gear cutting machines. Fork lift trucks pick up the hoppers and deposit the scrap into truck trailers. A spring latch activates the hopper. It rolls forward, dumps, and rolls back into upright locked position to receive the next load.

**64-0779**
Ficker, S., and A. Stieler. A new method of reclaiming scrap rubber. Rubber Age, 95(6):890-893, Sept. 1964.

The processes adopted for the mechanical separation of crushed tire material have rarely met demands with regard to good separation of the rubber granulate and the cord fibers, or, if met, the plant investment and energy costs were excessively high. Hence the rubber reclaiming industry is still dominated by chemical and especially thermal processes, which also suffer a number of disadvantages. A new mechanical process for reclaiming scrap rubber, especially old tires, is described which is characterized by an electrostatic separation stage. The processing stages include screening, sifting, and electrostatic separation. After leaving the sifter, the fiber-rubber mixture is fed into a Venturi whirler and moistened. The conditioned mixture is precipitated in a connected cyclone and then conveyed to the electrostatic separation unit where rubber and fibers are separated in four series-connected separators. In the electrical fields of the individual separation stages, special discharge electrodes cause a selective electrical charge of the fibers which separates them from the mixture. The electrical fields of the four separation stages are energized via a high-voltage cable by means of a high-tension rectifier. The separating efficiency can be regulated by varying the feed rate, the rotor speeds, the electrode voltage, and the external setting of the splitters. Depending on the composition of the mixture to be treated, it is possible to obtain 75 to 80 percent by weight of granulated rubber having a concentration of 98 percent. Suggestions are made to insure optimum conditions for the process, particularly with regard to the utilization of the cord fibers. It is concluded that this process opens up new prospects for the rubber and plastics industry, offering the possibility of recovering individual components of various compound materials.

**64-0780**
Filling an old sewer with pulverized fuel ash. Engineering, 197:293, Feb. 21, 1964.

Pulverized fuel ash is reported to have been used successfully for internally supporting about 1,200 ft of a 72 in. sewer which had reached a dangerous condition due to mining subsidence. Reasons for using fuel ash and the procedure for filling are discussed. The ash was found to spread easily and fill in all awkward cavities. Compaction was entirely satisfactory. Manpower was concentrated on the surface with only occasional visits below ground.

**64-0781**
Fly ash plant in operation. Electrical World, 162:61, July 13, 1964.

A plant for converting fly ash into three grades of lightweight aggregate by balling and then sintering is described. An important factor is the angle of the fly ash balling drum. This angle, formerly proprietary information, is 11 degrees. The advantage of fly ash aggregate is that it weighs only 1,800 lb per cu yd as compared with 3,000 lb per cu yd for the usual pebble and sand mixture. Formerly it cost a utility company $210,000 annually to dump 350,000 tons of fly ash. Now the lightweight aggregate sells for $5.50 per ton. It is estimated that 11 million tons of fly ash are generated annually, and that this figure will rise to 16 million tons within a few years. Company officials believe that all fly ash production could be absorbed by the concrete and asphalt industries.

**64-0782**
Fly ash steals the show at ECSA meeting. Rock Products, 67(10):102, 104, Oct. 1964.

Papers having to do with the use of lightweight aggregates in making concrete presented at the Expanded Clay and Shale Association's mid-year meeting in New York in Aug. 1964, are briefly summarized. A paper of special interest described production techniques for sintered fly ash aggregate, a first-class construction material that is of value for use in all forms of poured lightweight concrete and for the fabrication of structural building units. The pozzolanic strength of fly ash aggregate is superior to that of the raw material from which it is produced. Long-term improvements in strength have been demonstrated by its use. Other papers were concerned with the effect of accelerated curing conditions on the creep and shrinkage properties of concretes of the type frequently used in precasting plants, the variation in properties among concretes made with different lightweight aggregates, and the advantages of lightweight concrete.

**64-0783**
Fly ash usage studied in three-year project. Engineering News-Record, 172:160, Mar. 19, 1964.

The Battelle Memorial Institute in Columbus, Ohio, is studying commercial uses for fly ash in a 3-year project. The variability in quality of fly ash, depending on the coal and boiler used, is a major problem. The first part of the study will deal with the causes of variability and with ways to make fly ash more consistent. The second part will inquire into its uses, such as filler in asphalt pavement or lightweight aggregate in concrete.

**64-0784**
Frances, J. M. Mine-waste reclamation via vegetative stabilization. Kansas City, Mo., American Society of Agronomy, Nov. 16, 1964.

More than 200 acres of 'tailings'--mine waste--had accumulated since the late 1920's at a Bethlehem Steel Company dump site outside Lebanon, Pennsylvania. During 1961 to 1962, when the company began to relocate its Lebanon facilities, a protective covering of vegetation was decided upon to prevent dusting. Despite a discouraging soil analysis, a variety of alkaline-tolerant shrub and tree seedlings were planted; and with a hydroseeding technique and a slurry mix of mulch, fertilizer, and grass seed, a ¼- to ½-inch mantle was hydraulically applied. The planting was completed in less than 4 months and has survived, with continued good growth and color, 2 years of severe weather. In addition, the growth of various evergreens was successfully supported by an experimental plot which had not been stabilized in any way. This program is indicative that similar mine waste areas can be reclaimed, preventing barrenness and real estate loss.

**64-0785**
From old poles, new garden sculptures. Electrical World, 162(7):18, Sept. 14, 1964.

Cedar power poles, once used by Seattle City Light to carry transmission and distribution lines, are sold by the utility at $.10 per ft for use in bulkheads and pilings. In addition, a dozen per year go to Seattle's Pacific Prevocational School, where they are cut into 3-ft lengths, split in half, and then carved into sculptures by the students.

**64-0786**
Furlow, H. G., and H. A. Zollinger. Reclamation of refuse. Westinghouse Engineer, 24(3):80-85, May 1964.

Dumping and burning are unacceptable. Landfill sites soon become filled. Incineration is expensive, contributes to air pollution, and leaves a residue to be disposed. A reclamation process was developed by Naturizer, Inc., SACS Inc., and Westinghouse. Scales weigh trucks for computing charges. Refuse is dumped onto the floor. A vertical steel apron conveyor controls the amount of material. Paper, rags, metals, rubber, plastics, and glass (about 20 percent of tonnage) are removed for markets by conveyors. The remaining material is mixed and moistened in a pulverator. Moisture is increased from 25 to 55 percent moisture. Grinding speeds decomposition by exposing more surfaces for bacterial action. The digestor consists of six cells, insulated to retain heat. Temperature is kept under 160 degrees. After digestion the material is ground and screened. Final compost has 20 percent of volume and 80 percent of weight of incoming refuse. Compost is a source of humus for soil conditioning. A plant with a capacity of 300 tons per day costs $3,500,000. Disposal by landfill cost about $1.00 per ton but hauling costs are high. Incineration costs between $3.00 and $13.00. Sewage sludge with 5 percent solids would provide the right amount of moisture.

**64-0787**
Garland, S. T. Can the nation afford waste? Waste Trade World, 105(20):65, Nov. 14, 1964.

Britain as a trading nation imports most of her raw materials and exports finished products, which places a pressure on the economy to keep imports in balance. The salvage of usable waste materials should be encouraged by the government because this salvage represents millions of pounds which would otherwise be spent abroad. Actually, waste is a valuable raw material which can be reused many times. Scrap metal, rubber, plastics, and especially paper can be salvaged to avoid imports. The increasing demand for paper and packaging material has resulted in 30 percent of the raw materials in the paper trade in Britain coming from salvaged paper and packing material. The addition of a small amount of virgin pulp can result in satisfactory reuse of the waste paper as cartons and containers with a saving in terms of imports of at least £60 million. It is urged that since waste recovery is big business, legislation should be introduced to ensure its healthy growth. Millions of pounds have been spent on research on machinery and techniques of recovery and this work becomes more important as paper technology advances. The problem of contraries is becoming more difficult as they interfere with proper pulping. The contraries include paper clips, rubber bands, wet-strength paper, tar and plastic coated papers, cellophane, and polyethylene. The British Waste Paper Utilization Council is working in a drive in which they urge governmental and industrial support to produce waste paper free of the harmful contraries.

**64-0788**
Gentile, P. Resources for the future and industrial conservation. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.187-190.

Typically, municipal rubbish contains papers, cans, other metals, glass, rags, cardboard, tree clippings, and a wide variety of lesser amounts of miscellaneous materials. Some of these items, if separated economically, one from the other, could be used immediately in a variety of industries and may possibly be converted into the raw materials of an industry yet to be born. Without first separating the many fractions contained in rubbish, industrial conversion is unbearably complicated by the presence and nature of materials deleterious to the conversion process. At the same time, salvageable materials will be lost or so altered as to lose much of their value. Further, conversion of solid wastes into only one or possibly two marketable products critically limits the number of markets which can be reached. Because of the enormous quantities of materials produced even from a conversion plant, of modest size, any limited market is soon oversupplied, the result being lower and lower commodity prices. It is important to carefully combine the elements of 'separation' and 'salvage' into a complete conversion system in order to develop a greater variety of by-products and distribute the resultant items and raw materials to the most diversified market possible. This, then, has the effect of avoiding the supersaturation of any single market. Various separation equipment offered for sale and the techniques used are described, and some of the results obtained from these processes are discussed.

**64-0789**

Hayward, S. G. Waste paper is vitally important. Waste Trade World, 105(20):63-64, Nov. 14, 1964.

This review of the waste paper industry discusses the general problems and the importance of improving the quality and providing a dependable flow of waste paper to the paper and board mills. The British Waste Paper Utilization Council, which represents both the paper and board makers and the waste paper group, has accomplished a great deal in the last five years in impressing the waste paper producers of the seriousness of pernicious contraries in the waste. In addition to contact with individual companies and trade associations, the problem has been publicized through the national as well as the trade press. An attempt has been made to eliminate the pernicious contraries at the source, and to see that paper and board containing these pernicious additives are quickly recognizable. With waste paper prices unduly depressed and increased costs of transport, collection, and overhead, some salvagers of waste paper are in difficulty. In producing 4,000,000 tons of new paper and board, the mills use 1,420,000 tons of waste paper annually. The local authorities supply the lower grade used chiefly by the board mills, which account for 30 percent of the waste paper. The balance, including the better grades, is produced by the waste paper dealers. The dealers are the only collecting agency equipped to sort the waste, and without such sorting service there would be a shortage of the better grades for the paper mills and for export (100,000 tons annually). A healthy outlook is indicated for the waste paper industry if cooperation between the mills and the dealers continues to exist.

**64-0790**

Instant baling helps beat big wastepaper problem. Modern Sanitation and Building Maintenance, 16(2):30, Feb. 1964.

The Pan Am building management found that baling or binding the waste paper on the premises makes the job of removal easier. Waste paper is stored for 24 hr and then separated into salvageable paper, newspapers, tabulating cards, stationery, etc. Pernicious contraries consisting of unsalvageable rubbish are separated also. Salvageable material is dumped onto a conveyor belt and carried into an automatic baler. As soon as 1,000 lb of paper is in the baling machine, an electric eye cuts the bale off, and the bale is bound with a wire.

**64-0791**

Isotalo, I., L. Gottsching, N. E. Virkola, et al. Sawdust kraft pulp manufacture and its use in printing paper. Paper Trade Journal, 148(28):49, July 13, 1964.

The suitability of sawdust originating from a sawmill gang saw and edging saw for kraft pulp manufacture was studied. Pulps of different cooking degrees were prepared from sawdust originating from pine, spruce, and a mixture of 70 percent pine and 30 percent spruce in rotating laboratory digesters. Mixed sawdust was also cooked together with normal pine chips. Both bleached and unbleached pulps were tested for their ordinary paper-making properties, and the printing properties of the bleached pulp made from the mixture of pine and spruce were studied. The results indicated that kraft pulp with normal yields can be prepared from sawdust, with a cooking time that is somewhat shorter than usual. The strength properties of this pulp are clearly inferior to those of pulps made from chips, but are comparable with the corresponding properties of a number of hardwood pulps. The bleaching of sawdust pulp is fully comparable to the bleaching of chip pulp with the opacity of the bleached pulp being somewhat superior to that of a corresponding chip pulp. For the manufacture of printing paper, sawdust kraft pulp is considerably inferior to birch kraft pulp as regards breaking length and surface strength, but its other printing properties, stretch, tearing strength, and folding strength are not inferior.

**64-0792**

Jain, N. C., J. Singh, and D. D. Singh. Hardboards from lignocellulosic wastes.

Research and Industry, 9(4):104-106, Apr. 1964.

There are large quantities of different lignocellulosic waste materials in different industries which have a potential for use in the preparation of hardboards which have not been investigated. Since it may be difficult to find enough of one particular waste to meet the requirements of a hardboard plant, it is desirable to study the suitability of as many different waste materials as possible. Therefore, hemp waste and timber waste from processing deodar, rosewood, irul, and veneer waste were investigated by varying the duration of cooking with 2 to 10 percent sodium hydroxide in an open-pan digester from 2 to 4 hr. The material was then passed through a condux mill, converted into a wet mat, and hot-pressed to hardboard at a pressure of 56 kg per sq cm for 20 minutes at a temperature of 160 C. Table 1 shows the ratio of solid to liquid, the percent alkali, the cooking time, and the characteristics of the resulting boards. Density, mositure content, bending strength, and water absorption are recorded together with the effect of oil and heat-tempering on bending strength and water absorption. Table 2 shows the same information for mixed veneer waste. Untempered deodar wood waste gave a high bending strength and rosewood gave the poorest values. Boards from veneer wastes gave bending strength values as high as 495 kg per sq cm which was increased by oil-tempering at 170 C for 2 hr. The suitability of several types of lignocellulosic wastes for use in hardboards is reported.

**64-0793**

Kantawala, D., and H. D. Tomlinson. Comparative study of recovery of zinc and nickel by ion exchange media and chemical precipitation. Water and Sewage Works, 111(11):R280-R286, Nov. 30, 1964.

Efficiency of recovery of zinc and nickel from typical industrial wastes by ion exchange and observations of the effects of repeated usage of the resin on recovery efficiency are described. Efficiency of this method was compared with that of a chemical precipitation method, using lime, which has been extensively utilized in the recovery of metallic ions. A diagram of the equipment used is shown. The resin (Dowex 50W by 8) was a styrene polymer of the sulfonic acid type, crosslinked with divinylbenzene. Chemical precipitation takes advantage of the low solubility of metal hydroxides to force them out of solution by increasing the hydroxide ion concentration of the solution. Lime was used as the source of hydroxide ions. It was found that the efficiency of the ion exchange resin used in this study to recover zinc decreased from 99 percent to 64 percent with four consecutive runs and to recover nickel, decreased from 100 percent to 52 percent with three consecutive runs. This decrease in the efficiency of the resin with repeated use was probably due to decrease in efficiency of regenerant. The chemical precipitation method showed an increase in the recovery of zinc from 20 percent with simple flocculation without any lime addition to 99 percent with 1.76 mg of lime per mg of Zn in the waste at a pH of 10.0. Recovery of nickel by chemical precipitation showed an increase from 55 percent without any lime addition to 98.5 percent with 250 mg per liter of lime. The optimum quantity of lime required to precipitate zinc and nickel was nearly equal to the theoretical requirement to precipitate the metals completely. It was concluded that operation and control of hydrogen form cation exchange units during exhaustion cycles can be accomplished conveniently with the use of parameters like pH and specific conductance.

**64-0794**

Kingston, G. A. Iron and steel scrap in the Pacific Northwest. U.S. Bureau of Mines Information Circular No. 8243. [Washington], U.S. Department of the Interior, 1964. 50 p.

The report surveys the supply and consumption of iron and steel scrap in the Pacific Northwest, including Idaho and Montana, with emphasis on Oregon and Washington. It points out factors influencing the supply and consumption of scrap materials, such as the complete dependence of steel ingot producers in these States on scrap as a metal raw material and the sizable quantity of scrap exported from Seattle and Portland to Japan. The pattern of the industry is presented as a movement of materials from their diverse sources to the consuming market. The geographic locations of the consuming industries in relation to the areas generating scrap materials and the movement pattern of the supply from source to destination strongly influence the cost of the commodity. The best measure of the scrap supply available in an area is experienced in terms of how much scrap was withdrawn at a given price. Total withdrawals from Oregon and Washington are projected to 1.8 million tons by 1985, 60 percent (1.1 million tons) of which will be heavy melting grades. Numerous charts are given in addition to four appendices.

**64-0795**
Levine, S. Is the fly ash disposal problem solved? Part 1. Rock Products, 67(6):60-61, June 1964.

Three sintering plants which have gone into operation in the past year for conversion of fly ash into lightweight aggregate for concrete block manufacture and structural concrete application are mentioned. The continuous sintering process using a Dwight-Lloyd type of traveling grate is the basis for production of indurated fly ash pellets at the three new processing facilities. The chemical composition and physical properties of fly ash are noted, and the continuous sintering process is described. Advocates of fly ash use for lightweight aggregate cite four reasons why investment and operating output of a fly ash sintering plant should be less than a similar plant for expanded clay or shale: (1) Fly ash is a by-product, so that no mining or quarrying is required; (2) Fly ash is already fine enough for sintering, so that no crushing or grinding is required; (3) Fly ash contains 'built-in' fuel in the form of unburned carbon; and (4) Power plants are located near metropolitan areas, which are the principal market for lightweight aggregates.

**64-0796**
Lumber waste creates pollution. Compost Science, 4(4):32, Winter 1964.

Since as much as 50 percent of a log is waste material that is burned at small lumber mills, it contributes to air pollution. Oregon State University researchers suggest that better utilization is the only solution to the burning of logging wastes.

**64-0797**
MacDonald, D. Sintering profit from a waste-disposal problem. Chemical Engineering, 71(18):34, Aug. 31, 1964.

The Waylite Company has developed a sintering process that can convert fly ash into at least 1,000 tons per day of aggregate for concrete in three high-quality, lightweight grades. The company has a highly automated plant in River Rouge, Michigan, which converts the fly ash from the coal-burning operation of the Detroit Edison Co. The new aggregate is valuable to concrete users because its lightness reduces shipping costs.

**64-0798**
McGaugey, P. H. Processing, converting, and utilizing solid wastes. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.149-158.

Freedom to manage wastes by simply exporting from the city is now vastly constrained. Already it is difficult to export rubbish, garbage, cannery wastes, and debris from urban redevelopment and freeway construction. Burning it at any economically feasible location faces restraint by air pollution authorities, and landfill presupposes the availability of cheap unoccupied lands. Thus, the problem of disposing of large volumes of both solid and liquid wastes within the confines of the city is added to such traditionally unexportable problems as vector control, housing, mental health, and environmental sanitation, to which it bears an increasingly distinguishable relationship. Thus far no one has suggested a way in which research can be brought to bear on the problem of processing the remains of old houses and tree trunks whether for disposal or conversion to something useful. Processing of cannery wastes by methods other than fermentation is currently the subject of research. Business judgement, shrewdness, expert knowledge of markets, willingness to work long hours, and access to non-union labor among family or associates may be the factors which enable one salvage contractor to make a profit in a situation where another might be unable to survive. There are several problems in the utilization of sewage sludge. As with animal manures and compost, there is no agricultural demand for it. The cost of processing is high. In the absence of utilization as a strong motive in wastes management, research on processing and converting of wastes has proceeded in a partial vacuum.

**64-0799**
Million a year from scrap. Waste Trade World, 105(25):14, Dec. 19, 1964.

The Wrapping Reclamation Co. of Budapest with 300 employees is making almost 1,000,000 a year from waste that normally would go discarded. The company has contacts with all the factories and industrial cooperatives in Hungary and buys 6,500 tons of rubbish as raw material each year. The business is based on the buying and reclaiming of useless objects, with glassware the largest portion, including everything from medicine bottles to acid carboys. Steel plate barrels used to import carbide are converted to bitumen containers and supplied to the Pet Nitrogen Co. to replace 175,000 imported bitumen barrels which had cost $1.00 each. Salvage material includes scrap material and cardboard cartons which are made into wooden packing cases and paper sacks. Over 12,000,000 boxes have been returned to shoe factories alone. Based on their success, the company is asking for a governmental committee to co-ordinate work between Hungary's industrial ministries and the Packaging Technique Institute for the purpose of extending salvage operations.

**64-0800**
Mueller, W. J., S. Palinchak, and P. B. Stickney. Low-volatile coal fines as a filler-extender. Rubber Age, 95(6):407-412, June 1964.

The purpose was to determine the amount of low-volatile bituminous coal fines that could be added or substituted in rubber compositions without significantly affecting physical or mechanical properties. Compounding was carried out on a 6 by 12 in. laboratory mill and in a size B Banbury. Rubber compositions were mixed and molded in accordance with accepted laboratory techniques following an ASTM-15-62T method. Procedures used for testing included Mooney scorch and cure time, stress-strain, hardness, compression set, tear resistance, heat aging, crack growth, heat buildup, quality index, Banbury mixing power requirements, and compound Mooney. Four tables show bituminous coal fines in a passenger-tire-tread composition containing ISAF carbon black (mill-mixed) or HAF black (Mill-mixed), or prepared from an HAF-black masterbatch or an ISAF-black masterbatch. A fifth table gives the use of bituminous coal fines in reclaimed rubber. It was found that the addition of 7.5 to 10 phr of bituminous coal fines to black-filled SBR compositions (both mill-mixed and masterbatches) did not affect properties. Similar results were observed with reclaim compositions, where up to 15 phr of the coal fines could be used. In some compositions, odor and staining were reduced by the presence of the coal fines. It was concluded that the bituminous coal fines are a unique material which can be used by the rubber compounder to reduce costs without a significant sacrifice in properties.

**64-0801**
Naik, B. N. Putting leather waste to use. Compost Science, 4(4):29-30, Winter 1964.

Nitrogen is one of the most essential major plant nutrients. Leather waste, which consists of shavings or cuttings left in the fashioning of different leather goods, contains 8 to 14 percent of nitrogen in the form of proteins. But due to the 'tanning' process, the proteins are rendered refractory and it takes time to decompose, resulting in the low availability of nitrogen. It is necessary to process this material to render it easier for nitrification so that it can be used as manure or fertilizer. Experiments were performed with vegetable tanned and chrome tanned leather. The conversion of organic forms of nitrogen from untreated leather is very slow as compared to acid-treated ones. The acids used in the samples were sulfuric and hydrochloric. Material which is rich in nitrogen can be converted to a valuable fertilizer.

**64-0802**
Nancy, K. H., W. E. Gates, J. D. Eye, et al. The adsorption kinetics of ABS [illegible] fly ash. In Proceedings; Nineteenth Industrial Waste Conference, Lafayette, Ind., May 5-7, 1964. Purdue University Engineering Extension Series No. 117. p.146-160.

Waste water recovery often uses activated charcoal as the adsorbent, but it is expensive. One of the cheapest and most available materials is fly ash, the waste material of the electric powder industry which is produced in large quantities during the burning of powdered coal at high temperatures. A 1,000-million-watt power plant will produce 1,000 tons of fly ash daily. In 1964 about 20 million tons will be produced in the United States. Although it has been used as an adsorbent in Europe, fly ash has been thought to be poor in comparison with activated charcoal. The kinetics of adsorption of the two were believed the same. Fly ash is composed of silica, iron oxides, alumina, lime, and carbon. It is fine and has a large surface area per unit of volume and a wide particle size distribution. An electron microscope micrograph is given. The physical properties of five different types are given in a table. Alkyl benzene sulfonate (ABS) was used as the adsorbate in this study, since it is a characteristic organic refractory in many waste waters and there are methods for its determination in dilute solutions. It was found that the removal of ABS proceeds rapidly after initial contact and then continues at increasingly slower rates. Several days may be required for equilibrium to be reached. This is a slow process. The rate of adsorption of ABS was found to be highly time dependent. (A formula is developed for this.) Carbon content was an extremely important factor. The removal of ABS increased as the content of carbon increased. Using 1000 mg per liter of fly ash containing 23.27 percent carbon, 74 percent removal of ABS was achieved in a 2-hr contact. (Fly ash now available contains between 3 and 30 percent carbon.) Fly ash should be considered as a potential adsorbent in waste water renovation. Topics for further study are given.

**64-0803**
Nateson, K., D. R. Ketkar, and R. Mallikarjunan. Beneficiation of dross dust from brass melting. Research and Industry, 9(12):363-365, Dec. 1964.

Although the dross dust from the melting of brass contains 30 to 40 percent brass, the high proportion of non-metallics makes the dross unsuitable for remelting or recharging to the melting units. Because of the limited resources in India of copper and zinc, the beneficiation of the brass dross to permit recovery of the metallics would save the country 200,000 rupees a year in foreign exchange. Flow sheets are given for two methods of concentrating the copper found in the dross on a laboratory scale. A simple washing with water will increase the copper from 24 percent in the dross to 39.01 percent which when followed by wet grinding in a ball mill and further water washing will give a concentrate with 44.4 percent copper for a recovery of metallics of 78 percent. The other flow sheet shows a concentration from 17.35 percent copper to 30 percent on water washing and a further concentration to 38.39 percent following treatment with 10 percent sulfuric acid to give a metallics recovery of 80.3 percent. It was found that the acid treatment has a marked effect in upgrading the simply washed material, but does not improve the grade of the ground material. Either process--the water washing followed by wet grinding and washing or treatment with sulfuric acid after the initial washing followed by another washing--will give a concentrate which, when dried, can be charged into the melting units. The loss of valuable brass as dross from an ordnance factory can be avoided by these methods.

**64-0804**
New bulk refuse feeder shows promise. American City, 79(3):34, Mar. 1964.

A new refuse feeder overcomes drawbacks of apron or vibrating types. Advantages include greater safety, simplicity of design, feed accuracy, and lower initial and maintenance cost. The feeder unit, consisting of a drag chain conveyor suspended from a carriage, moves up and down the length of a receiving hopper beneath. It may be installed in all plants where refuse is sorted and segregated from conveyors for salvage purposes.

**64-0805**
Oates, J. T. How municipalities can use wood chips. Compost Science, 4(4):24, Winter 1964.

More than 50 cu yd of wood chips are obtained daily by the Richmond, Virginia, Tree Division. Composted chips have given the necessary aeration and relief of compaction for mulch. Composted chips are favored over raw chips because it is easier to have effective soil acidity control.

**64-0806**
Pardoe, G. C. Big tyre accumulations post serious problem. Waste Trade World, 105(20):45-46, Nov. 14, 1964.

Outlets for the 12,000,000 scrap tires which are discarded each year are less than 50 percent and prices are down 50 percent below those of 2 years ago. The only tires that the merchants will buy are those with useful casings or tonnage tires for export. Passenger casings valued at 15s to £1 when remolded are priced from 2s to 5s when purchased by the remolders. The small casing dealers will probably be forced out of business if the casing prices go any lower. It is suggested that the original tire casing with sufficient rubber on the tread area, properly grooved, is as safe, if not safer, than a retread. The strength of the tire is in the cords or canvasses and not in the rubber. Tire regrooving becomes unsafe when tires are regrooved that were already too thin. The whole pattern for scrap tires is downwards and they will probably become valueless as is the case in other countries (except for nominal values to be paid by reclaimers to cover transportation costs). The faster car on modern roads will increase the tendency of the motorist to buy new tires rather than remolds. This will depress the the casings price even further. Used tires should be exported to undeveloped countries where there is a definite shortage of tires and casings. The practice of some manufacturers and remolders of mutilating all worn tires and casings is wasteful, since these tires could be exported at more than the scrap value. The future for used tires is in export.

**64-0807**

Pearson, A. S. Lightweight aggregate from fly ash. Civil Engineering, 34(9):50-53, Sept. 1964.

The Consolidated Edison plant for sintering fly ash for aggregate which can produce 1,000 tons per day of usable material is described. Sintering fly ash was approved by the New York City Board of Standards and Appeals as a lightweight aggregate in construction. In the Consolidated Edison system alone, 400,000 tons of fly ash were collected in 1963 with a removal cost of $1.75 a ton. In 1980, over 25 million tons of fly ash will be collected in the United States. Fly ash with a moisture content of 22 percent is pelletized and then sintered in furnaces into a cake of clustered pellets and clinker which are broken up and crushed and screened to conform to ASTM specification C 330 with a nominal size from ¾ in. down to material retained on a No. 4 screen. Although large amounts of fly ash have been used in the manufacture of cement, stabilization of soils, and in asphalt pavement, the use as a sintered light aggregate for concrete structures and products is the only known application with the potential capacity for utilizing fly ash in the volume necessary to keep abreast of the production.

**64-0808**

Power station ash aids industrial development and public recreation and safety. Engineering and Boiler House Review, 79(4):137, Apr. 1964.

Examples of the applications of power-station ash are described. In the Fleetwood project, pulverized fuel ash is being used to reclaim about 30 acres of marshland from the sea. The cost of the project, begun in 1963, will be more than £25,000 and it will take about 10 years to complete. A sketch map of the area is shown and the two-stage reclamation process is described. First, an earth bund is built which will be reinforced with stone on the tidal side to prevent erosion. When completed, it will keep tidal water out of the 30 acres of marshland. In the second stage, water-borne ash will be pumped from a power station onto the marshland via a 10-in.-diameter pipe. When the desired level of ash is reached, the surface will be grassed. In the Chadderton project, thousands of tons of ash from the power station have been used to fill in eight disused mill lodges and ponds which were dangerous for children playing in the area. The latest stage of the project involves the draining and filling-in of two ponds at a disused brickworks. The ash leaving the power station is mixed with 18 percent water to eliminate dust until the project is completed, and a suitable top dressing will be provided. In addition to the use of ash for safety purposes, thousands of tons have been used to convert a rough, 30-acre site into attractive playing fields.

**64-0809**

Pure copper from impure scrap. Coal and Base Minerals of Southern Africa, 12(9):39, 41, Nov. 1964.

An industrial plant is described whose function is to convert certain low grade copper-based slags and drosses which result from foundry operations into electrolytic copper. The basic units consist of a blast furnace, two rotary furnaces, and an electrolysis recovery unit. The blast furnace, originally designed for high grade coke, was modified for use with local coke with a high ash residue. The low grade alloy which emerges from this furnace is unsuitable for direct electrolysis and has to be further fire refined by the rotary furnaces for removal of zinc and iron. After refining in the rotary furnaces, the metal is cast into 250 lb anodes of approximately 95 percent copper purity. The electrolysis is carried out in 72 cells working at a current density of 13.5 amps per sq ft of cathode. Of the 72 cells, eight are used for the continuous production of starting sheets and 64 for commercial production. As each cell contains 12 cathodes, the total weight recovered after 2 weeks growth in each cell is approximately 1 ton. The sludge from the cells is rich in tin and lead and contains approximately 10 percent copper in a metallic state. Before recovering the tin and lead in solder form, the metallic copper is removed by acid digestion at high temperature. The tin-lead sludge is dried before being sold for its tin and lead content to a firm which specializes in its use. The present capacity of the plant is about 120 short tons of electrolytic copper per month, although provision has been made for the rapid doubling of this capacity should circumstances permit.

**64-0810**

Reddy, K. R. Lignite tar from Neyveli as road binder. Research and Industry, 9(8):235, Aug. 1964.

The road binder prepared from Neyveli lignite tar is not satisfactory because of the large amounts of paraffins (18% against 5% for a good binder), therefore a means of reducing the paraffin is needed. A road binder can be made from Neyveli lignite tar (18% paraffins) by distilling the tar at 280 C (14% paraffins) and air blowing in the presence of a catalyst (12% paraffins) in order to increase its softening point to 54 C. After refluxing with a small amount of creosote oils and lignite tar oils, the road binders obtained conform to most of the specifications for road tars (IS:215). Compared to the coal-tar binders, Neyveli lignite tar road binders have less ductility, less shining appearance, and a high susceptilility to temperature changes. Since these defects are due to the large amounts of paraffins (12% after air blowing), the necessity to remove the paraffins from the lignite tar or to reduce them to some chemical form (by the possible addition of other chemicals) which would not have deleterious effects on the other characteristics of the Neyveli lignite tar is urgent. Scientists who have worked in this field should share their experience and suggest some practical, economical, effective method of removing the difficulties experienced in utilizing the Neyveli lignite tar.

**64-0811**
Re-Metal salvage. Waste Trade World, 105(9):10, Aug. 29, 1964.

The services of the Re-Metal Co. of Bolton in the reclamation of worn or defective machine parts including special work involving the spraying of wear or corrosion resistant metals are described. A picture is given of a metal-sprayed roller being ground to size as typical of the work done. The metal-spraying technique is useful in rebuilding worn parts and reclaiming expensive components which otherwise would be scrapped. It is claimed that many materials, where the bearing surface only is worn, can be reclaimed. The reclamation work is varied and includes shafts, rotors, armatures, electric motor end shields, rollers, bowls, crankshafts, and spindles, which can be sprayed with almost any metal or ceramic, including steel, bronze, brass, stainless steels, copper, nickel, zinc, aluminum, and aluminum bronze. It is possible to spray hardened parts and the base metal does not have to be the same type as the deposited coating. The process does not generate enough heat to distort the work. Depending on the requirements, any thickness from 0.005 to 0.5 in. or over may be deposited to provide an ideal bearing surface for moving parts because it is hard wearing, retains oil, and had a low coefficient of friction. Hydraulic rams, sprayed with stainless steel have a corrosion-resistant, smooth, hard surface which gives long life to the metal and the leather. The first order from one customer was a vacuum cleaner rotor and the second was a roller weighing 16 tons. The service is intended to keep many machine parts from the scrap heap.

**64-0812**
Revolutionary method of Dr. Caspari. Compost Science, 4(4):28, Winter 1964.

Experiments of Dr. Caspari, Germany, have shown that a high-quality soil improvement substance in the form of briquets can be made from sewage sludge and urban wastes.

**64-0813**
Sanders, N. Memphis' salvage operations prove profitable. Electrical World, 161:103, Apr. 6, 1964.

Conversion of scrap, such as brass fittings from street light bulbs, insulated copper wire and lead-covered cable, has been made a profitable business by a Tennessee company. A key tool in the scrap conversion is an incinerator which has modernized the stripping operation. Gas burners raise the furnace temperature to 1,200 to 1,600 F to burn off the insulation from the copper wire. Ashes are knocked from the wire by hand, leaving the clean copper. Lead from cables is melted at 750 F and is drawn off to a pig mold protruding from the rear of the incinerator. Hardened pigs drop automatically to the floor. Each lead pig weighs 82 lb, and each incinerator load produces 40 to 60 pigs equal to 87,568 lb per year, which is valued at $8,478. The ashes are salvaged and sold to junk dealers at a price higher than that which would be required to haul them away. In addition, gas burners in the stack burn the smoke sufficiently so that only a thin, gray haze is emitted to the atmosphere.

**64-0814**
Sattar, A. Fish meal and manure--their preparations and uses. Compost Science, 4(4):30-31, Winter 1964.

Fishmeal or fish manure in Pakistan can be prepared by either dry or wet method. In the dry method marine fish scraps are sundried.

The product is kept overnight in a kiln and milled into a fine powder. Because the product has a bad odor and harmful bacteria which may affect the taste of eggs and milk when consumed by poultry and cattle, the scraps may be processed in modern plants in which they are pulverized and then subjected in a digestor to high steam and pressure. Oils are extracted and used as adhesive for arsenical sprays. The digested scraps and offal are dried in a rotary steam-oven at 200 F. The mass is ground into a fine powder through a roller. Under the wet method, the material is directly processed without sun-drying. The product is of better quality. Fishmeal is used as cattle and poultry feed to provide protein. The manure supplies nitrogen and phosphorous to the soil. It is applied in furrows and trenches after being mixed with surface soil to prevent its being taken from the surface by cattle and birds. It is applied in winter to prevent exhaustive decomposition in summer.

**64-0815**
Seek bulk outlets for fly ash. Electrical World, 161(6):45-46, Feb. 10, 1964.

An investigation was carried out to reveal areas for which fly ash could be utilized, such as fill material for embankments and land reclamation. Field density measurements showed that the tailgating method of dispersions resulted in a wide variation in the shear strength of the tailgated fly ash, thereby causing local slide failures. A drawing is given to show the preferred embankment design. This design uses horizontal filters to control drainage. It was concluded that compacting fly ash increases storage about 27 percent over that realized by tailgating, and leads to a homogeneous embankment with high shear strengths. A novel ash handling system was also described. The system employs gravity-induced-flow from four mechanical collector hoppers to a storage silo where it is then moistened and trucked to a disposal area.

**64-0816**
Senning, J. A. Taking profit from waste. Los Angeles Herald Examiner, No. 300, Jan. 20, 1964.

A new waste disposal machine is described and its possible uses explored. Called a Lantz Convertor, it takes any plant or vegetable matter, including wood, and reduces it to a marketable charcoal. Simultaneously it yields a combustible gas of which approximately 40 percent is used to fuel the converter and 60 percent is stored for other needs. The converter produces charcoal in 30 minute cycles and can handle up to 2 ton per hr. New York City officials are interested because of the 200,000 tons of demolition wood which they have been dumping at sea until now. Other factions interested are slaughter houses and coffee makers.

**64-0817**
Shirksalkar, M. M., R. K. Jain, and J. George. Fire-resistant building boards from coconut pith. Research and Industry, 9(12):359-361, Dec. 1964.

Large quantities of unretted coconut husk pith (a by-product of the mechanical defibrination of coconut husk to obtain fibers for bristles or upholstery cushioning material) are being wasted, which otherwise could be used in production of fire-resistant lightweight building boards and in expansion joint fillers. The unretted pith containing tannin, pectin, hemicelluloses, etc., was compounded with hardboard pulp and with a pulp prepared from banana stems. The sieve analysis of the pith was given in one table. Another table shows the properties of the pith-fiber slabs produced from varying percentages of fiber and with 50 percent banana stem fiber. The flexural strength increases with wood fiber content, with the modulus of rupture as high as 16.5 kg per sq cm at 50 percent fiber (average 10.2 kg per sq cm). A value of 23 kg per sq cm is obtained with 50 percent banana stem pulp. The 50 percent wood fiber does not propagate flame, and the banana stem fiber is even more fire-resistant. Compressibility and recovery from compression are within the requirements of IS: 1831 to 196 . Boards containing 30 percent fiber and 70 percent pith should make a satisfactory expansion joint filler. The cost is estimated to be Rs 1.90 per sq m for 12 mm thickness. A use for the waste unretted coconut pith is outlined which provides low density fire-resistant insulation board (and is also suitable as an expansion joint filler) when combined with other fibrous material.

**64-0818**
Skitt, J. Magnetic separators. In Disposal works: plant and maintenance. London, Temple Press Books Ltd., 1964. p.19-22.

Ferrous metals are generally separated from refuse before incineration since the presence of cans in the furnace is not conducive to a good clinker. The magnetic pulley arrangement consits of an electromagnetic head pulley. The refuse is discharged as the conveyor passes over the drum, but the ferrous metals cling to the magnetized drum and follow the conveyor on its return path until the belt leaves the drum, when the cans are discharged separately. A stationary electromagnet of semicircular cross-section is fitted inside a rotating drum over which the refuse passes. Ferrous metals cling to the drum while in the magnetic field and are carried to the underside of the drum before being released. Magnetic separators were at one time fitted at the discharge end of the rotary screen where the ferrous metals came under the influence of the electromagnets. The overband magnetic separator is supported at variable heights above a refuse-carrying belt at a point beyond that at which hand sorting is carried out, enabling the extraction of objects likely to cause a choke. The clearance between the belt below the magnet and the picking conveyor should be adjusted to suit the width to overcome possible chokage. The overband separator is now generally accepted as being the most efficient, with the best results obtained by installing two separators on each line with disturbance of the refuse between them. The use of a magnetic drum or pulley in addition to an overband separator has proved a good combination. It is desirable that all cans accumulate at one baling point without handling.

**64-0819**

Sludge treatment and disposal. Public Works, 95(8):74, Aug. 1964.

In Richmond, Virginia, the sludge from the sewage treatment plant is digested and then discharged to open air drying beds. After drying, it is spread on open fields at the plant site, and a Payloader is used for crushing and stockpiling it for later use on park areas and lawns. A portion of the 52 million cu ft of gas produced was used as fuel for plant heating and for power for pumping the raw sludge. A gas pipe break, caused by a 15-ft-deep scum blanket, damaged a fixed cover on a 95-ft-diameter digester. The unit was cleaned and repaired, and a gas mixing system was installed to supplement the original mixing equipment. Laboratory work has been carried on with a pilot scale model digester built of clear plastic and equipped with heating and mixing devices. To eliminate or reduce the need for lime as a neutralizing agent, extensive studies on digester start-up and pH control have been conducted.

**64-0820**

Smith, E. L. Kraft mill chemical recovery units--the third generation. Paper Trade Journal, 140(44):30-34, Nov. 2, 1964.

The development of the chemical recovery furnace through three generations is reviewed. Detailed diagrams are given of the first-, second-, and third-generation recovery units whose capacity increased from 20 pulp tons per day to 1,000 pulp tons per day. The third generation of recovery units was initiated in 1954, and although they do not differ radically from the second generation ones, a number of new features were incorporated. The 1,000 ton recovery unit, the largest to date, burns 3,000,000 lb of dry solids per day at 65 to 68 percent solids and generates over 500,000 lb of steam per hr at 600 psig, 715 F at superheater outlet. Its features include a cascade evaporator, black-liquor pumps, dissolving tank, and F-D fan. Future designs and new safety features are briefly discussed, and a detailed diagram of a recently developed starting burner which incorporates many new safety features is included.

**64-0821**

Snyder, M. J. Properties and uses of fly ash. Battelle Technical Review, 13(2):14-18, Feb. 1964.

Fly ash is a complex, heterogeneous material exhibiting wide variations in chemical and physical properties. A table is given illustrating chemical variability. As much as 75 to 80 percent of the ash passes from the furnace as small discrete particles. World production and utilization of fly ash are given. Fly ash is used as a constituent of concrete to react with calcium hydroxide at ordinary temperatures and to form cementitious compounds. The amount of fly ash added affects the long-time strength of the concrete, and lowers the water requirements for concrete mixes. However, fly ash can also lower both the early strength of concrete mix and the entrained-air content. Fly ash is also mixed with lime for soil stabilization and is used as a mineral filler in bitumastic road construction. Lightweight aggregates can be made by sintering fly ash, and a variety of ceramic products can be made from fly ash and clay or shale. However, a lack of fundamental studies of the chemical reactions and physical interactions between fly ash and concreting and soil materials has limited these uses of fly ash. Recently begun research at Battelle for the Edison Electric Institute includes studies on the pozzolanic reactions of fly ash and the mechanism by which fly ash depresses air entrainment in concrete.

**64-0822**
Story, W. S. Problems of the salvage industry as they relate to solid waste disposal. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.159-167.

If the secondary materials industry were to close its door tomorrow throughout the nation, cities and municipalities would be faced with difficult problems of solid waste disposal. The difficulties encountered would be doubly and trebly multiplied, and the highways and byways of the nation would be choked with old automobiles, old refrigerators, cardboard, paper, rags, stoves, and everything else of a solid or semisolid salvageable nature. The peddlers and other types of collectors, the little junk dealer, and junk shop operator are the backbone of the collection of obsolescent material. Various scrap processing operations are described. The problems dealing with tin can scrap are discussed. As a result of the slowdown in steelmaking demand for scrap, more and more of this scrap is finding its way to the dumps. This presents problems for everyone, and it represents sheer economic waste of valuable metallic resources which should not be permitted. Research in steelmaking can provide some of the answers to these problems. Research in cleaning deleterious materials from steel scrap perhaps can give us other answers. One area which has not been researched enough is the salvage area.

**64-0823**
Tank cars line caisson. Engineering News-Record, 173(1):84-85, July 2, 1964.

Faced with one of the most difficult foundation problems ever encountered in Chicago, the general contractor saved great expense by salvaging the tanks from railroad tank cars for use as caisson liners for foundations supporting a 30-story office building. The subsoil profile of the $25 million building contained a strange inversion of the hardpan and silt layers which posed a tremendous obstacle to orthodox caisson-sinking methods. As fast as the excavators broke through the layer of hardpan, the silt oozed upward through the holes. Pumped to the surface, it might have left empty pockets into which the hardpan would collapse, creating still more obstacles to the foundation work. The plan devised by the engineers--which used as, the key element the tank cars stripped to their basic cylindrical shape, is described.

**64-0824**
Taylor, J. L. Growing importance of alloy scrap. Waste Trade World, 105(20):48-49, Nov. 14, 1964.

The use of stainless steels and other alloys in high performance piston engines has resulted in an increase in scrap alloys on the market. There has been a number of larger merchants who have set up sections to handle alloy scrap and eliminate the specialized middle-men except for the complex grades. Some of the market is restricted by the larger customers' going into the scrap business themselves and becoming their own buying agents. In 1962 and early 1963, the only scrap in demand was that of very high quality and turnings were without value. Since the latter part of 1963, the demand for nickel has increased. Most of the merchants sell to specialized merchants since most merchants do not have the volume of material or the knowledge to obtain customers for their alloys. The drawback of selling direct is the need to provide metal of guaranteed specifications, which requires the use of skilled sorters, who are scarce. The penalties for supplying alloys with unwanted elements can be considerable. The difficult sorting is based on the magnet; the recognition of the basic grades and presence of certain elements is determined by the color of the sparks from the grindstone. Spot tests which, while reliable, have become too complicated. A combination of these tests gives a good degree of accuracy, but not enough to give any quality guarantees. For detailed information on establishing the nickel content of a scrap, chemical or spectrographic analysis is required, which is an expense that must be assumed to meet the customer's requirements.

**64-0825**
Trigg, C. F. Blast furnace slag and pulverized fuel ash as road foundation materials. Roads and Road Construction, 42(495):75-81, Mar. 1964.

A description, classification, and chemical analysis are given for blast furnace slag and pulverized fuel ash. Tests were carried out in order to determine their suitability as road foundation materials, including crushing tests for blast furnace slag and the California

Bearing Test (C.B.R.), which measures load penetration. Graphs show grading curves of the slag and fuel ash as well as penetration related to load and sinkage related to load. Laboratory tests--including bulk density and C.B.R. percent--on blast furnace slag, on pulverized fuel ash, and on a combination of the two, are reported along with results on full scale field compaction of pulverized fuel ash. Based on crushing values and surface texture, blast furnace slag was separated into two grades with 40 percent satisfying the requirements of Grade No. 1, which provides a product comparable in strength and fragment shape to good-quality quarried roadstone and which, when compacted with fines, offers a satisfactory road base course. Pulverized fuel ash is a more uniform product, but its particle size curve is within the limits of a poorly graded silt, which under adverse groundwater and weather conditions is likely to become unstable and to be affected by frost heave at shallow depths. If the fuel ash is used with blast furnace slag, it is possible that minimum C.B.R. requirements would be achieved with little difficulty at an early stage and, due to its age hardening properties, progressive improvement in the sub-base course would occur. When used as a blinding material to fill the voids between the slag fragments, crushed blast furnace slag would provide a course with C.B.R. in excess of 90 percent, but it has the disadvantage of having a high sulfate content in relation to the Grade No. 1 slag.

**64-0826**
Turn waste into sales. Rock Products, 67(5):121-122, May 1964.

The conversion of waste to profits at the Limestone Div. of Wallick Coal, Inc., is described. A narrowing profit margin from stripping to get to a 22-in. seam of No. 4 coal made it necessary for stripping cost to be cut if the operation were to remain competitive. It was decided to market the previously wasted limestone, and a new 300 tph crushing and screening plant was designed and built. The plant and its operation are described. In addition, a bag-type dust collector was installed and the limestone crusher dust was sold at $3 per ton, a process which turned the problem of excessive dust into a profit. The company has found that instead of being squeezed out of the market by the difficulties of mining a marginal deposit, they are able to remain competitive in the coal business and have widened their total marketing horizons.

**64-0827**
Utilization of metallurgical wastes. Journal of Scientific and Industrial Research, 23(8):315-316, Aug. 1964.

The National Metallurgical Laboratory, Jamshedpur, organized a symposium, held during March 1964, on the utilization of metallurgical wastes to bring together the planners, industrialists, and research workers to assess the situation and exchange views. A brief, topical survey is given of the papers presented. The Laboratory reported on work it had done, including recovery of mine wastes in the form of low-grade ore discards, treatment of different types of slags produced in the iron and steel industry, and treatment of drosses, swarfs, skimmings, and residues by various metallurgical techniques. It was noted that some of the papers from advanced countries provide research possibilities and technological information which can be of benefit to Indian workers. However, any large-scale undertaking in waste utilization should necessarily be limited to the development of indigenous technology since the waste materials to be handled are peculiar to India.

**64-0828**
Utilization of power station by-products. Waste Trade World, 105(16):24, Oct. 17, 1964.

The uses of pulverized fuel ash and slag tap clinker in civil engineering and construction are described. The pulverized fuel ash once regarded as waste has a potential that was demonstrated by having the floor and five of the stand walls of the Central Electricity Generating Board station at the Manchester Building Trades Exhibition built of products containing pulverized fuel ash (PFA) or slabs of PFA. Several of the exhibits show the use of PFA as a structural filling, in grouting, and in large-scale concrete construction to obtain the maximum reduction of temperature rise during hydration. The manufacture and uses of sintered PFA and its value as a lightweight aggregate are described. Arrangements are being made to have the Central Electricity Generating Board's PFA technical staff concentrate on research and development of new uses for PFA, disseminating information and giving technical assistance to potential users. In the North Western Region most of the salable output--900,000 tons a year--is being utilized in civil engineering and the building industries. From the new cyclone-type furnace, slag tap clinker--a hard, black, gritty, granular material which is free from dust--is obtained. It is inert, free running, and cannot be compacted, thus it has different uses than PFA. Although the first cyclone-type furnace has only recently begun operation, the material has already established itself as suitable for winter gritting of roads, drains, filtering, brick-making, flagging, road-making, and as aggregate.

**64-0829**
Waste really pays off. Factory, 122(8):137, Aug. 1964.

The General Electric Company's Hanford Works, Richland, Washington, has several chemical processing plants and mine production reactors to make plutonium. In each reactor an aluminum cladding of fuel elements takes place. The job of the chemical plants is to dissolve this cladding and extract plutonium. In one plant sodium nitrate does the dissolving. Afterwards, the nitrate goes with other liquid waste into an underground storage tank. The nitrate salts drop out of the solution and form a solid layer at the tank bottom. Next, the liquid wastes are transferred to less expensive tanks for storage. This leaves several feet of solids at the bottom. Agitation and leaching over a 3-month period removes 85 percent of the solids, leaving a solution of 30 percent sodium nitrate.

**64-0830**
Waste reclamation plant, termed a success, gets big company backing. Chemical Engineering, 71(6):88, Mar. 16, 1964.

Salvage and Conversion System's compost process, which has been offered to municipalities by Westinghouse Electric Corporation and which is now used in a 150-ton-per-day plant in San Fernando, California, is described.

**64-0831**
Where the board comes from. Public Cleansing, 54(11):1278, Nov. 1964.

The Thames Board Mills, which makes cardboard out of waste paper, and production of cardboard in England are discussed. The Mills can produce 80,000 tons of packaging cardboard per year. Twenty percent of the paper and cardboard consumed by the United Kingdom comes from converted waste paper. The use of waste paper as opposed to pulp involves expensive cleaning processes and, therefore, puts England at a competitive disadvantage with other countries.

**64-0832**
Wirt, R. L., and W. A. Rumberger. Eastern sintering plant now producing fly ash pellets. Part 2. Rock Products, 67(6):62-66, June 1964.

The new semi-commercial fly ash sintering plant of Niagara Mohawk Power Corp., which converts fly ash from the steam electric-power station using pulverized coal into heat-hardened pellets, is described in detail. A flow diagram of the sintering plant and photographs of various steps in the process are included. Feed preparation, pelletizing, and sintering are described with detailed diagrams of each of the three stages. The sintering machine is essentially a Dwight-Lloyd type of traveling grate, 3½ ft wide with an active area 44 ft long. The first half of the area is covered with drying and ignition hoods. Under the drying hood, five burners using No. 2 fuel oil and recycled hot gases from the burning area of the grate evaporate water from the pellets. Under the ignition hood, eight oil burners aided by recycled hot gases maintain a temperature of about 2,200 F. This raises the temperature of the pellets high enough to ignite the unburned carbon in the fly ash as the pellets are exposed to the downdraft process air. A combustion air diagram shows the operating conditions of the sintering process. Measurement of operating conditions and safety-dust handling are mentioned. A major equipment reference list is given.

**64-0833**
Wood chips as litter for cattle and poultry. Agriculture, 71(12):570-574, Dec. 1964.

The use of machine-chipped wood from forest and sawmill waste as litter for cattle and poultry is reported. Industrial wood waste is generally more economical than straw for all types and systems of cattle housing and has been used extensively in the United States, where all species of timber except the turpentine-yielding pines are acceptable. The all-purpose chip suitable for both cows and poultry should have good absorbency, be non-toxic, free from dust and splinters, unlikely to pack down with use, and in plentiful supply. A flaky type of chip about 1 mm thick and one-half to three-fourths of an inch long for poultry and slightly longer for cattle is considered the most suitable. A prototype machine to produce this type of chip was developed at the Forest Products Research Laboratory by the modification of a pitprop peeling machine. A mobile, tractor-driven machine priced at £181 is now on the market. Litter prepared by the mobile units proved satisfactory in covered yards, for housed stock, and for poultry. Pictures are given showing loose-housed cows resting on a bed of shavings, the standard chips, and some fine chips for loose housing. Sawdust has an advantage for stalls in that it does not get kicked around. Flakes prepared from air-dry timber have a moisture content of 28 to 30 percent of their dry weight, but absorb 200 to 300 percent moisture. In none of the trials was there any injury or irritation to the cattle or poultry. The extent of their use as litter will depend on the local price of straw.

## SALVAGING AUTOMOBILES

**64-0834**
Aderholdt, A. A. The District of Columbia's car removal program. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.T-1 to T-5.

Two programs are described by the Deputy Chief, Metropolitan Police Department. One is directed at cars abandoned on private property, and the other at those left on public space or the streets. The two programs exist mostly because of legal technicalities. During the last 14 months more than 7,000 vehicles have been moved from private property and 2,500 from public. This does not include all vehicles, only those 'abandoned', that is, one stripped of identification, and usually with the wheels or the motor missing. The owner has no further use for it and is trying to get rid of it. The vehicles removed from private property are not taken into possession by the police. They are removed by an auto wrecker from the place of abandonment directly to his processing yard at the request of the property owners. The role of the police is solely one of introduction; they introduce the property owner to the auto wrecker or vice versa. It is believed that the property owner has a right to remove trash (a used refrigerator, a worn-out bed spring) from his property. Under District law, a property owner can be prosecuted for leaving an abandoned vehicle on his property if it is there long enough to become a health menace. The history of this program is traced and described. Vehicles left on public property involve the issuance of traffic violation notices for each illegally parked vehicle. If there is no response, the vehicle is impounded and held 60 days. If not claimed, it is sold at public auction. This program is also described and the results given.

**64-0835**
Background sheet; terms used; statistical background. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.A-1, B-1 to B-5, C-1.

Certain data are presented as background material. More than 5 million cars go out of service each year, and nearly 8 million new cars are produced each year. The scrap processor prepares a stripped car for the use of a steel mill after it has been stripped of saleable parts by the autowrecker in an auto graveyard. A junkman collects miscellaneous waste (iron, paper, rags, glass), sorts it, and sells it to the processors. (Junkmen are often one-man enterprises with little capital investment.) Changing steelmaking methods have reduced the demand for scrap; the average annual purchases for 1960 to 1963 were 26.6 million tons, while in years 1954 to 1957 the average was 34.8 million tons. Prices are down. The price for No. 2 bundles made of stripped, baled cars is now $20 a gross ton, as low as it has ever been. Modern cars contain much non-ferrous metal (copper, rubber, glass, plastic) which must be removed, since it alters steelmaking formulas. The labor involved is costly hand labor. Scrap is iron and steel scrap. Metals include all non-ferrous metals. Waste consists of rags, paper, glass, plastics, etc. It is not destroyed, but is processed and reclaimed for reuse. Junk is secondary materials sorted but unprocessed. Scrap is not junk. The organization of the industry and its nomenclature are set forth. The sources of scrap, including prompt industrial and home, obsolescence, are described. The techniques and equipment used in preparing scrap are summarized. The names used in the trade for the different types of finished product are listed. A page of statistical data is also presented. Steel ingot production in millions of net tons, percent of production capacity, purchased scrap used, price, total consumption, factory sales of cars, and cars out of service, are given for the period 1954 to 1963.

**64-0836**
Budin, M. Progress report; New York State study of auto graveyards. In Proceedings;

National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.R-1 to R-12.

The author and his organization are working with a committee of the New York legislature. Their point of view is that of a public authority: what effects (aesthetic, land value, economic, tourism,) there are on the total community. The legislator has to face certain problems, one of which may be the storage of automobile bodies whether for speculation, inventory, or partial dismantling purposes. Control of these stockpiles may be necessary in spite of the advances in industrial technology. Location is a problem due to zoning. Camouflage may be a factor. Incineration and the related problem of air pollution are considerations. Abandoned autos are a public nuisance, an eyesore, and a fire hazard. In the total picture, why should abandoned autos be thought of as different from any other solid waste that the community has a responsibility to handle? The problem has been divided, for administrative reasons, into two parts: the economic and technologic aspects (being attacked by the author's firm); and the legal (being analyzed by the Office of Municipal Government in Albany). The scrap industry has been studied as a whole, and 250 scrap processors, auto wreckers, and junk collectors in New York State have been interviewed. Three areas (Syracuse, a middle-sized city; Amsterdam, a typical small-sized city of 30,000; and Schoharie county with no medium or large cities in it) have been mapped, and every abandoned car, every scrap dealer, every informal scrap dealer, and every rural scrap yard that has grown up on a farm or on farm land has been located. What was found is described in detail. As a result of this study, it can be estimated that there are 300,000 abandoned cars around the state at the present time. A scale model of the city of Amsterdam was made with the cars located on it, and plans have been made for dealing with the problem. Quotations from the interviews are given.

**64-0837**
Callahan, J. M. Obituary of an auto. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.J-1 to J-3.

Nearly 4 million cars are junked each year. The typical junker is compressed into a 1,500 lb bale of scrap steel which is combined with iron ore to produce new steel. The grey iron, copper, aluminum, lead, solder, tin, and zinc are also sold to foundries and mills which may sell it to the auto industry. Auto wreckers may strip a car of everything but the carbon steel body. Scrap dealers process and prepare the body so that it can be dumped into a steel mill's open hearth furnace. Nine to 10 years and 90,000 miles after it leaves the dealer, the average U.S. car is ready to be junked and is sold to an auto wrecker for $10 to $175. (average: $25 to $45.). The activity and procedures of a typical wrecker (Babcock Iron & Metal Company, Detroit) are described.

**64-0838**
Cooper, A. Derelict cars are wasted assets. Waste Trade World, 105(20):27-28, Nov. 14, 1964.

Although a million cars a year, representing 500,000 tons of good steelmaking material, will go to the scrap heap in 1970, there are economic reasons for recovering abandoned cars. In addition to the £6 million value of the junk cars as scrap, they are an intolerable nuisance. While it is an offense to abandon a vehicle on a highway or private property, no arrangements have been made for dealing with old vehicles left on roads, in ditches, and in fields where the removal problem increases. In the United States, nearly 5 million old cars were scrapped in 1962 to produce 4 million tons of steelmaking scrap worth £50,000,000. It was found impossible to deal with the problem effectively, except to regard it as a national problem. The same conclusion was reached in Germany, and eventually Great Britain will have to consider why such an essential metal is being wasted in a country which is short of basic raw materials. Apparently, no single industry can provide the solution. The scrap industry could take old cars and make them into material suitable for use in iron and steel if the municipal councils would allow the use of land for breaking up old vehicles, and give assistance in dealing with the smoke nuisance. The problem is a national one and can be resolved only by the combined efforts of industry and the municipal authorities with the guidance and cooperation of the government.

**64-0839**
Dumpsters can handle derelict cars. Public Cleansing, 54(3):802, Mar. 1964.

A Dumpster developed by the Powell Duffryn Engineering Co. Ltd. of England can be utilized to tow away cars. It can also lift and carry cars that cannot be towed with a special chain attachment.

**64-0840**

Giles, J. S. The auto graveyard--what to do about it? In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.V-1 to V-5.

The secondary materials industry in the United States and its relation to the solid waste disposal problem are discussed. Certain facts are brought out: $3 billion per year gross sales; 4 million tons of scrap metal salvaged; 8,000 auto graveyards; and every ton of ferrous metal scrap used again saves up to 2 tons of iron ore, a ton of coke and a half ton of limestone. Forecasts include: 115 million vehicles by 1984; population 267 million; and no liability insurance available. The role of the Institute of Scrap Iron and Steel in the national picture and the salvage operator in the local community is stressed. Three factors account for the increase in junked cars: owners do not keep their cars as long; 1953 to 1955 was a peak period in production, and sales and those cars are now being junked; and basic technological changes in the making of steel. There is less demand for automotive scrap. The process of producing auto scrap is described, and the economic forces at work are emphasized.

**64-0841**

Go-anywhere mobile 'car-crusher'. Waste Trade World, 105(10):7-8, Sept. 5, 1964.

Progress in solving the problem of a million unwanted automobiles which are expected to litter Britain by 1970 is anticipated by the world's largest mobile baling press, which is capable of pressing two saloon bodies into a 1 ton bale in 3 minutes. The PSC.376 Scrapmaster, weighing 40 tons and designed to handle 18 cars per hr, without their engines, is mounted on a trailer. It has an electrically-controlled hydraulic press with its own self-contained power plant, fuel tank and hydraulic oil reservoir. All varieties of metal scrap, as well as car bodies, can be dropped into the 7-ft wide, 3-ft deep and 20-ft long box for lateral and vertical compression into compact bundles. Following this, a hydraulic ram moving at high speed and low pressure, which shifts to medium speed and medium pressure, and to low speed and high pressure (as the resistance of the scrap increases) ejects the finished bale. The box closes at 90-tons pressure and the ram exerts a pressure of 330 tons. A picture is given showing the Scrapmaster being loaded. The whole car, minus only the engine, is baled (the glass, upholstery, and other nonmetal parts are removed in the preliminary burning). The machine can also bale four car engines at a time. The mobile Scrapmaster will visit without charge any area which has from 500 to 1,000 cars. One solution to the disposal of derelict cars is for local authorities to operate central dumps, which could be visited by the Scrapmaster at periodical intervals when there is an accumulation of scrap and cars.

**64-0842**

Green, M. The community and the scrap yard. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.N-1 to N-2.

Scrap processors require a considerable investment: at least $150,000 to $175,000, since the press which can take an entire car body may itself cost $125,000 to $175,000 installed and equipped with the crane, magnet, and grapple needed to feed it. There are few national or regional scrap processors. Most are individually owned businesses operating in a single community. Some of these date back to the Civil War. Whether there is a scrap processor in a community or not, scrap is produced involuntarily, and something must be done with it; either the scrap processor does it or a public agency does it at public expense. The scrap processor is in a position the reverse of the car dealer, although their functions are the same. Almost all the money the scrap processor spends to acquire his inventory is spent locally. Very few other retail stores or manufacturing plants do this. This has a favorable effect upon community relations. The local scrap processor is often a person who has been in business for years, operates a business of substance, takes part in community affairs, and makes most of his expenditures locally. These factors should have some influence on community officials in their plans.

**64-0843**

How an automobile is stripped by a scrap processor. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.H-1.

Cars compressed in this operation weigh about 3,300 lb. Materials removed are listed in sequence: shrinkage, 15 percent, (rubber mats, hose, glass, seats, rubber, upholstery); radiator and heater (25 lb); generator, starter, heater motor, and horns (50 lb); die cast and other white metals (grills, ornaments, carburetors, fuel pumps, instrument panels, door handles, 30 lb); copper wire and cables, copper tubing (5 lb); headlights, tail lights, radio, lights, hubcaps, and all electrical assemblies (75 lb); stainless and chrome steel (5 lb); tires and tubes (100 lb); and motor block and transmission (600 lb). A total of 1,385 lb has been removed. The remainder consists of the body and chassis, front and rear ends, springs, bumpers, and steel wheels. It weighs 1,900 to 2,000 lb.

**64-0844**
Incineration of automobile bodies. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.I-1 to I-2.

Burning automobile bodies is expensive and, because of the uncertainties of the scrap market, loans for such equipment have not been easy to get. An automobile incinerator is a highly specialized piece of equipment designed for only one type of scrap which presently has a low profit margin. When all useable parts have been stripped from a car three types of basically ferrous materials remain: the steel parts (frame and axles); cast iron (motor); and sheet iron (the auto body itself). Auto scrap includes the steel and sheet iron, but not the cast iron, and is compressed into cubes called No. 2 bundles. Steel mills specify that non-metallics are to be excluded; they are buying steel not wood or rubber. The steel mills are not concerned with how the non-metallics are removed, but burning the entire body removes two unwanted materials--the undercoating and some lead. Smokeless incinerators are necessary instead of open burning because of the desire of the community to control atmospheric pollution. Research has developed a smokeless incinerator costing $20,500 to $22,000. The cost per car would be $7 to $9. Some communities (e.g. Grand Rapids, Michigan) allow open burning at specified times during the day or under specified weather conditions.

**64-0845**
Kaiser, E. R., and J. Tolciss. Burning proven best to clean auto steel. Refuse Removal Journal, 7(11):18, Nov. 1964.

Burning is a practical way to clean auto steel. What is needed is an economical and efficient auto-burner furnace which does not pollute the air. A report given at a New York meeting of the Air Pollution Control Association, which establishes basic facts and equipment needed to operate such a furnace is discussed.

**64-0846**
Liebman, H. Statement. In Proceedings;. National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.U-1 to U-3.

The Director of Operations, Department of Sanitation, the City of New York, presents data on the number of cars removed from city streets. In 1960 only 2,500, in 1961 5,117, and in 1964 approximately 25,000 cars were removed. The procedures and problems encountered, and their present solutions are described.

**64-0847**
Manchester, H. Old cars never die. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.X-1 to X-3.

The life history of an automobile bought in the spring of 1955 and pulled into a giant wrecking plant in Chicago in early 1963 where it was after three minutes transformed into an unrecognizable assortment of basic materials is described. The process, at the General Iron Industries' No. 1 plant is described step by step from the time the car is weighed on a platform scale until the final bale the size of a console TV set is produced. The economics of the industry are surveyed. New uses of scrapped cars include: reefs of old cars used as 'apartments' for red snappers in the Gulf of Mexico; old cars used to form a reef as part of an island built by an oil company off the coast of California; and junked cars used to check erosion near Jacksonville, Florida.

**64-0848**
New US car-a-minute grinding process. Waste Trade World, 105(7):8-9, Aug. 15, 1964.

A 'fragmentizer' which reduces car bodies to fist-sized metal pellets in one minute is being tried in California as a solution to the derelict car problem. The car bodies are fed to the fragmentizer on a conveyor belt travelling at 400 ft per sec. In the auto shredder the cars are battered by 50 hammers, each weighing 850 lb and swinging from flywheels, which smash the car bodies into smaller and smaller pieces until they drop through spaced bars in the hammer chamber floor into a rotating magnetic drum. Here, the glass, rubber, plastics, cloth, copper, and paint chips are separated to give a final product of pellet-sized fragments which are 98 percent ferrous and are called Lurmet. A photograph is shown of the Lurmet fragments ready for shipment to the steel mills as a high-quality raw material. The pellets are a third denser than the usual burned out and baled auto scrap. Another picture shows motor car bodies entering the shredder of fragmentizer on the conveyor to be reduced in a minute to Lurmet. Bethlehem Steel Corp. has been testing 15,000 tons of the pellets in a nearby mill. Although steel production is increasing and the 1964 production is likely to be 2 million tons above 1956, the scrap sales of 2 billion will be one-third below the 1956 peak. Oxygen furnaces use very little, if any, scrap; open hearth furnaces use less scrap with the use of oxygen; and molten iron is becoming low enough in price to replace some scrap. Increased sales of scrap can only come from providing high-quality scrap at prices competitive to molten metal prices.

**64-0849**

Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. 122 p.

A glossary of terms, some statistics, a list of participants (at the end, on pages numbered one through five), and a list of papers or statements on such topics as the scrap processor's role in auto salvage, retired cars as by-products of progress (by a representative of the Automobile Manufacturers Association), scrap and the steel industry, the economics of scrapping a car, legal aspects, the community and the scrap yard, new technology, state auto graveyard studies, and new developments and trends are included.

**64-0850**

Proler, I., and W. Magness. Technological developments in the scrap industry - I; Technological developments in the scrap industry - II. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.O-1 to O-5, P-1 to P-4.

Part I is a discussion of the technological changes in the baling, shearing, and shredding methods of preparing the scrapped automobile for steel mill or foundry consumption. Twenty-five or 30 years ago the method was to chop up or torch the body into pieces small enough to be baled in a small hydraulic baler. The understructure of the car was cut by acetylene torch or small alligator shear into 5 x 1½ ft pieces or smaller. These were known as Number 2 heavy melting steel. Number 2 bundles were 30 x 24 x 24 in. or smaller, and contained contaminants such as paint, wood, and non-ferrous metals. The understructure contained copper. At the blast furnace, these bundles have to be diluted with hot metal to keep the residual copper and other non-ferrous metals to a minimum. Hydraulic balers then became larger. Alligator shears were replaced, in some instances, by larger hydraulic guillotine shears. At present, balers are able to consume an entire automobile, with or without the understructure. Hydraulic shears are able to take an entire car, compress it, and shear it into a scrap item known as automobile slabs, or sheared auto scrap. A film was shown of the largest baling press in the world in operation at the Proler Steel Corp. Two automobiles can be compressed at once in 1½ to 2 minutes. The scrap is reduced to small bits, and the contaminants removed. Part II also has a film narrated by William Magness of Luria Bros. & Co., New York. A giant unit called a fragmentizer rips and shreds entire cars with such violence that the non-ferrous metals, dirt, rubber, and undesirable matter are knocked loose for easy separation later. Product contamination and air pollution are avoided. The narration of the film included a description of the procedures used.

**64-0851**

Rapoport, F. The economics of scrapping a car. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.G-1 to G-7.

A car costing about $3,000 at birth must be transformed after death into something with economic value of about 1 cent per lb or $20 per ton. The investment varies from about $100,000 for an operator in a small city to about $1 million for a metropolitan operator. Abandoned and wrecked cars usually enter the auto-wrecker's yards, where they are cannibalized of all saleable parts, burned, and delivered to a scrap processor. However, so many cars are being abandoned that the auto wreckers can not handle the flow, so the scrap processor now often operates a fleet of two trucks to move the junked cars from the municipal storage yard to his premises. Two principal processes are necessary in the production of good automobile body scrap: removal of combustible contaminants by fire; and the physical removal of undesired metal. Incinerators must be used to control smoke emission in most communities. Three types of incinerators are: after-burner; water-wash type; and electrostatic precipitator. The after-burner is used by the author's firm. He describes: the early pilot model that burned two cards a day; a 20,000 gal tank converted into a horizontal primary chamber using propane as a fuel; and the present incinerator that burns 80 to 90 cars daily and is refractory lined, conveyorized, and has automatic temperature controls. The incinerator requires the use of a crane and two large lift trucks. Employees include operators for the equipment, a torch man, an incinerator operator, and impact tool man who removes tires and wheels, three teams of two men each for stripping. Cars are acquired in an uncrushed and unflattened condition so that the men can have easy access to remove parts. The process is described in some detail.

**64-0852**
Reichert, D. Legal aspects of the car disposal problem. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.K-1 to K-7, L-1 to L-5, M-1 to M-5.

Scrap processors alter otherwise useless waste into something of value, and act as major sources of raw materials for steel mills and foundries. Scrap processors have been held to be manufacturers as far as taxation is concerned, and certain court decisions are cited and reviewed in support of this. Scrap processors are not junkmen, nor are their premises junkyards. Scrap processors do not have to be fenced, and legislation requiring non-transparent fences has been found to be unconstitutional since there is no compelling health, moral, or public interest reason for it. Limited access, zoning, finger-printing of employees, and other matters of interest to the trade are discussed from the point of view of the Special Counsel, Institute of Scrap Iron and Steel. Two court decisions illustrating these matters are given.

**64-0853**
Roblin, D. A. Scrap and the steel industry. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.F-1 to F-8.

Two basic raw materials from which steel is made are molten pig iron and scrap steel. Molten pig iron is produced from iron ore in blast furnaces. Scrap comes from the steel mills themselves as a by-product since only 70 percent of their product is shipped as finished products. This is called home scrap. Purchased scrap is of two kinds: production or industrial scrap; and new steel resulting from the production of manufactured products (flashing in a forge plant, trimmings in a stamping plant, or turnings in a machine shop). This material is clean, free of foreign material, and generally chemically uniform. The second class is first, demolition scrap from bridges, oil refineries, railroads, etc. and second, everything else (drums, tin cans, and old automobiles). Of the various types of scrap the old automobile is in the least desirable category. The old car contains non-metallic impurities which reduce the yield when melted. More serious is the fact that it contains metallic impurities that are difficult and costly to remove. When the steel industry reduces the amount of scrap it purchases, it naturally eliminates the less desirable items. So, at a time when more cars are being scrapped, the demand for scrapped cars becomes negligible. The number of cars scrapped each year is going to increase. Certain changes in the steel industry, the oxygen converter, for example, which can consume not more than 30 percent scrap, as opposed to the open hearth which can use 35 to 50 or as high as 60 percent scrap, have contributed to this lack of demand. A cheap and ingenious method must be found for cleaning the old automobile so that economic value can be realized from this commodity.

**64-0854**
Roe, S. S. Retired cars: by-products of progress. In Proceedings; National Conference on Auto Salvage. Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.E-1 to E-8.

Production of vehicles in the 10 year period before World War II averaged 3.5 million cars per year, and these cars are now being discarded. In every year since 1948 production has been more than 5 million vehicles, and in 1963, it was 9.1 million. Nearly 85 million vehicles are registered. The importance of the automobile industry to the economy is cited: 780,000 employees; one industry in six is a motor vehicle industry; $12 billion in special taxes paid by owners; and one-fourth of all state revenues come from motor vehicles. About 50 percent of a given model will have disappeared at the end of about 10 1/2 years.

After about 5 years, the rate of disappearance begins to accelerate, and this partly explains the increase in scrappage recently experienced since the cars produced in the relatively high production years of the mid-50's have now reached the age when the annual disappearance rate is quite high. Charts are given for motor vehicle production in millions for 1930 to 1964, motor vehicle registrations for 1945 to 1964, passenger car survival rates, and motor vehicle scrappage in millions for 1935 to 1964.

**64-0855**
Shapiro, I. D. The scrap processor's role in auto salvage. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.D-1 to D-6.

The terms junkman, auto wrecker, and scrap processor are defined. The junkman collects and sorts all kinds of waste. The auto wrecker strips old cars for the resale of parts. Both provide raw material for the scrap processor who prepares the raw material in shapes and sizes acceptable to mills and foundries. The scrap processor may use cranes, trucks, scales, shears, balers, shredders, incinerators, cutting torches, magnets, grapples, and other equipment. An investment of about $250,000 may be required. While old cars are worth reclaiming, the cycle has broken down because of changing technology in steel production with less reliance on scrap and resultant lower prices. Scrap is bought by mills and foundries at prices, times, and quantities they set. Automobile scrap is costly and difficult to prepare, and hand labor is involved. The scrap processor is a manufacturer working in an outdoor factory with expensive equipment--there are 5-million-dollar shredding machines. More than 300 hydraulic guillotine shears are in use in the industry. Some of the problems of the industry in urban renewal and in community relations in general are described.

**64-0856**
'Total loss' cars should be scrapped. Waste Trade World, 105(18):24, Oct. 31, 1964.

Insurance interests are urging that damaged cars involved in accidents on which the basis of payment was that of 'total loss' should be scrapped and stripped to prevent repair by unscrupulous and/or incompetent dealers. Unsound cars which had been salvaged from road accidents were a road hazard and the cause of further accidents and substantial losses to the insurance companies. A large number of unsound cars would be removed from the road if all cars involved in 'total loss' accidents were scrapped for parts, and the registration book surrendered. The registration book should be held in any case until the car is repaired and checked by a competent engineer, but scrapping is preferred. This plan presents problems because of the increasing numbers of cars being scrapped as a result of rapid obsolescence and lack of interest in this work, even by specialists in the field. It is felt that the returns are too limited for the space, time, and trouble required in disposal of cars. In many yards, it is the practice to save obviously worthwhile materials with little attention paid to the rest, and to use extensive burning to save handling costs.

**64-0857**
Weinstein, A. Report on state auto graveyard studies. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.Q-1.

The author is chairman of the Committee on State Autowrecking Studies, Institute of Scrap Iron and Steel. The Committee is studying the problem of old and abandoned automobiles. Technological advances in processing equipment such as the shredders have eliminated the problem in four major areas: Los Angeles, Houston, Chicago, and Kansas City, and perhaps will soon solve the problem in the larger metropolitan areas. The problem is related to: population concentrations; technological advances in processing equipment; sale value of scrap; the extent of the export market; cooperation of government agencies; and the relationship of the quality of the Number 2 bundles to the changing technology of the steel industry. The Committee is working on novel approaches without reference to what has been done. Because of the importance of scrap as a basic raw material for the steel industry, as an earner of foreign exchange, and as a conservator of our own iron ore, a solution must be found.

**64-0858**
Westminister's way of dealing with the old car problem. Public Cleansing, 54(11):1297-1298, Nov. 1964.

Westminister has developed a new way of dealing with the removal and disposal of old cars and vans. A letter and circular which are posted in public housing and are advertised in newspapers announce that the city will dispose of old cars for a fee. Through this direct service, the city hopes to eliminate the annoying administrative work associated with ordinary procedures of vehicle removal. The circular outlines the removal and disposal costs by weight, and gives general information on how a resident may take advantage of this service. After the first 6 weeks of operation, four cars had been brought in by their owners.

**64-0859**
Where do old cars go to die? In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.Y-1 to Y-5.

An interview with Palmer Bell, who runs a junk yard 8 miles south of Atlanta, Georgia, is reported. He has 7,000 twisted auto bodies on his 43-acre lot. He paid $40 to $75 apiece for cars bought from the city's auto pounds, insurance companies, and private owners. He sells accessories and parts, but the metal is of little value. Although 5.3 million cars were scrapped in 1963 (new cars produced totaled 7.6 million), sales of scrap to steel mills was down drastically. In 1956 total steel scrap brought $3 billion but in 1958 was down to 1.5 billion and in 1963 was $1.9 billion. Wreckers can still sell parts, but the clean-up men, the scrap processors, can not make money baling cars for the steel mills. The price for a 1-ton bale is now $19.84 and the lowest since the war. In 1956 the same sized bale sold for $42.86. The changeover by the steel mills to the basic oxygen furnace has halved the amount of auto scrap used, and it must now be of higher quality. The difficulties of the auto wreckers are discussed both in specific, personal terms ('In Detroit last week, stocky Samuel Topper,...put it vividly...') and in terms of the national economy. The experiments and technological advances of the Luria and of the Proler firms are described. The police activity reabandoned cars is discussed with particular regard to Chicago's approach.

**64-0860**
Wolfsohn, V. Legislation, relocation, and beautification. In Proceedings; National Conference on Auto Salvage, Washington, Oct. 1, 1964. Institute of Scrap Iron and Steel. p.S-1 to S-5.

The author, Director of Public Relations for the Institute of Scrap Iron and Steel, quotes from a letter from the sanitarian of Del Norte County, California, regarding the problem of abandoned cars there. The experience of the city of Paterson, New Jersey, with a public tower is related. Only about 5 percent of the 140 cars a month that he tows off the street are ever reclaimed. There is a real problem of title, and changes in the law are suggested. The experience of Chicago is cited. Des Moines, Iowa, is considering the establishment of a central scrap area. Rome, New York, has tried this and their experience is reported. Oklahoma City is trying an urban renewal plan through which 56 used auto parts and junk yards will be relocated in an attractively screened and well-located supermarket for salvage. St. Paul has had a problem because its Port Authority condemned an area including several scrap yards which have no place to relocate. Gerald Mangle, assistant city planner of that city, spoke on this problem. Beautification is mentioned and the instance of West Virginia, where legislation supported by 200 auto wreckers has brought about the planting of 25,000 trees and 10,000 shrubs is cited.

## SANITARY LANDFILL

**64-0861**
Bauman, L. Decomposition creates danger in landfill. In 1964 Sanitation Industry Yearbook. New York, RRJ Publishing Corp., [1964]. p.29.

Sanitary landfills at Arlington, Massachusetts, and Queens, New York, are examples of dangerous building up of methane gas formed by decomposing garbage. A Scottish landfill inadvertently buried explosive sheets.

**64-0862**
A big concave blade. American City, 79(11):10, Nov. 1964.

Muskegee, Oklahoma, uses a crawler tractor with a big, U-shaped bulldozer blade for its sanitary landfill. This unit clears new areas, excavates the trenches and spreads and covers the fill much more effectively than a tractor with a straight blade.

## Sanitary Landfill

**64-0863**
Black, R. J. Sanitary landfills. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.120-127.

There are four methods currently used to dispose of refuse on land. They are: open dumping; controlled burning dumping; refuse filling; and sanitary landfilling. Commonly reported operating cost ranges per ton are, respectively, $ 0.10 to 0.25, $ 0.25 to 0.50, $ 0.35 to 0.75, and $ 0.70 to 1.50. Unfortunately, there is more than a little confusion in the technical literature on this matter of nomenclature because of the tendency to label all landfilling operations as 'sanitary landfills' in the vain hope that such labeling, by itself, will insure public acceptance of the operation. Sanitary landfill is defined as a method of disposing of refuse on land without creating nuisances or hazards to public health or safety, by utilizing the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each day's operation, or at much more frequent intervals as may be necessary. Two research projects on sanitary landfilling have been awarded by the Public Health Service. The title of the project, the name of the principal investigator, the institution, and a brief description of the scope of work are given. More specific information is needed to plan better and more economical operations of sanitary landfilling as a method of refuse disposal for the future.

**64-0864**
Broffle, R. W. Landfill capacity doubled by use of compacting method. Refuse Removal Journal, 7(2):14, Feb. 1964.

A four-wheel-drive, 50,000-pound compactor has compressed the layers of refuse and earth fill to just half the thickness managed by conventional bulldozers in a Riverside, California, landfill. As a result, the land used up for refuse has dropped from an acre a month to four-tenths of an acre per month. This system also allows the sanitation department to maintain hard-surface roads through the landfill area, cutting tire damage by 50 percent and reducing axle breakdowns. Furthermore, it reduces fire hazards to a minimum since flames cannot work their way down into the compressed fill. The developing stages of trash disposal before the city's final transition to a landfill, and how the city eliminated the threat of a washout posed by the landfill's location on river bottom land are also described.

**64-0865**
City of 19,000 provides landfill and equipment. Refuse Removal Journal, 7(8):20, Aug. 1964.

Batavia, New York, has replaced a crawler type tractor with a rubber tired tractor loader for its sanitary landfill. As a result, the city has been able to eliminate two 5-yd dump trucks and their drivers, to save in overtime and maintenance, and to compact the refuse and cover material better.

**64-0866**
Collect 2.8 million tons annually at New Jersey landfill. Refuse Removal Journal, 7(6):8, 20, 30-31, June 1964.

The history and operation of the Fereday and Meyer collection company of Newark, New Jersey, and its subsidiary, Disposal Areas Inc., which Fereday and Meyer set up in 1953 to handle their huge sanitary landfill at Elizabeth are described. Fereday and Meyer services several commercial and industrial pickup routes in the Metropolitan New Jersey Area, as well as small town routes. The landfill's daily intake of refuse from its own operation, other private haulers, and municipalities approximates 900 tons. It has brought more than 1,300 acres of tidal marshland to grade through the trench and cover method. Part of the filled section now supports an industrial complex and some 14,000 ft of arterial roadways.

**64-0867**
Controlled tipping in Germany. Surveyor and Municipal Engineer, 124(3782):29-30, Nov. 28, 1964.

A review of a paper concerning refuse disposal in Germany by controlled tipping is presented. Some comparisons with the situation in Great Britain are drawn, and it is shown that the position in Germany is very poor because of the degree to which crude rather than controlled tipping is carried out. Problems arising from this practice, especially concerning water pollution and sanitation, are discussed. Suggestions are made about the machinery required to maintain a tip and about the construction of one.

**64-0868**
Controlled tipping--past, present, future. Public Cleansing, 54(10):1229, Oct. 1964.

S. K. Sheldon, Director of Public Cleansing of Carlisle, England, presented a paper entitled 'Controlled Tipping--Past, Present and Future,' at a meeting of the Northeastern Center of the Institute of Public Cleansing. He noted that, in the past, controlled tipping was adequately executed, but now this form of refuse disposal is generally deteriorating chiefly because of the change in the nature of refuse. A critical problem is the shortage of cover material arising from the decrease in household ash, which has traditionally been used as cover. The solution lies in some form of pre-treatment--either incineration, composting, or pulverization. Household refuse is also analyzed.

**64-0869**
Denver looks for new disposal sites. Refuse Removal Journal, 7(5):31, May 1964.

Denver, Colorado, has three almost completely filled landfills and one burning dump, which is about to be scrapped, and is now searching for new refuse disposal sites. City officials have filed application with the federal government for surplus Lowry Field bombing range land, originally donated to Lowry by Denver. This area would provide dump space for another 20 to 50 years.

**64-0870**
Disposal costs cut by use of landfill. Refuse Removal Journal, 7(1):28, Jan. 1964.

The City of Calgary, Canada, is saving more than $300,000 annually by disposing of its refuse in sanitary landfills. Incineration, which accounts for 40,000 tons of waste per year, costs the city about $4.00 per ton as compared to the $1.25 per ton for the landfill.

**64-0871**
Disposal of bulk wastes. Public Works, 95(10):100-102, Oct. 1964.

At the present time New York City disposes of its outsize bulky waste at six landfill sites. Two of these fills are specially designated as construction waste landfills where the demolition lumber is burned in burning pits. At the other four locations both combustibles and noncombustibles are accepted. The combustibles are burned in pits, and the noncombustibles are buried. The sites and method of disposal in burning pits are described in detail. Over 600,000 tons of demolition and construction wastes were disposed of in 1963. Abandoned cars and 110,000 tons of bulky refuse collected from homeowners added to the load. Disposal of waste lumber resulting from pier or other waterfront demolition has been resolved partially by barging and burning at sea. This operation is conducted by private companies. Since, as of January 1, 1966, all outdoor burning will be prohibited, a decision will have to be made prior to that time as to the most sanitary, economical and efficient method of disposal of these waste materials.

**64-0872**
Disposal problems in the County of Stirling. Public Cleansing, 54(9):1170, Sept. 1964.

The annual report of the Northwestern Division of Stirling County is summarized. Refuse disposal problems are caused by the rapidly diminishing life of the tip and the shortage of top cover. The solution may lie in a hybrid disposal plant combining incineration, composting, and pulverization.

**64-0873**
Dump areas unsafe for home building? Refuse Removal Journal, 7(9):58, Sept. 1964.

The County Sanitary Landfill Committee of Los Angeles, California, has reported to the Board of Supervisors that old dump areas are unsafe sites for the construction of residential housing. It recommends that, when such areas have been reclaimed, they should be adapted for open-space recreational use and low-density industrial utility. The committee further recommended that building permits for rubbish disposal sites should be granted only after the filing of approved engineering plans designating the proposed future use of the reclaimed land.

**64-0874**
Fundamentals of sanitary landfill operation. Public Works, 95(12):88, Dec. 1964.

Some factors to be considered in establishing a landfill are location, collection methods, haul distances, accessibility, types of refuse, and equipment. The advantages of the landfill area and trench methods are also discussed.

**64-0875**

Gas production in a sanitary landfill. Public Works, 95(2):84-87, 174, Feb. 1964.

In a 3-year study of the factors controlling the use of a sanitary landfill site, conducted by the Department of Civil Engineering at the University of Southern California, the quality of the gases produced in the decomposition of refuse was studied. Temperature and humidity measurements were also determined. The method is described, and the following conclusions given: (1) the gases produced within the anaerobic landfills consist chiefly of carbon dioxide and nitrogen. The concentration of methane depended upon the moisture content and varied from little more than a trace, in the landfill constructed without the addition of water, to that of a major component in the saturated landfill; (2) hydrogen was present occasionally in very small amounts; (3) the production of methane was markedly increased by surface irrigation; (4) the concentration of oxygen did not exceed 10 percent; (5) the gases produced appeared to be under positive pressure and diffused laterally and vertically downward into the surrounding earth, as well as upward through the top cover; (6) the initial peak temperature within all landfills was reached within 3 months and occurred at varying depths; no significantly higher temperatures were reached thereafter; (7) the initial temperatures in the aerobic landfill greatly exceeded those in the anaerobic landfills.

**64-0876**

Goode, C. S. Utilization of sanitary landfill sites. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.128-135.

To overcome the various objections and to convince the Planning Commissions and other local officials of the necessity for the location of a proposed sanitary landfill often requires the efforts of a super salesman. In most cases, plans are needed. Plans which merely create a fairly level area of higher elevation are usually not convincing. The opponents of a chosen location and the local officials will want to know why the refuse disposal site in this area is necessary. To answer these questions, the haul distances and their costs, the relationship of the chosen site to other disposal areas, its capacity, the estimated population which can be served over the useful life of the disposal facility must be presented. The creation of a master plan for a rapidly growing community is quite a problem. Although it is fairly simple to project the ultimate population growth on the basis of such things as topography and the availability of water, it is practically impossible to predict where and when increments of growth will occur. The cooperation of cities and counties is a must. The coordination with departments representing city, county, and state planning, highways, recreation, and schools is extremely helpful. Some of the problems faced by San Diego County in the past and some of the projected plans and the various methods used to overcome these problems are discussed.

**64-0877**

Groff, G. and W. A. Taylor. Treatment plant located on former landfill site. Public Works, 95(6):105-107, June 1964.

The $1,834,600 primary sewage treatment plant and interceptor system completed in Missoula, Montana, in January 1964, will abate the pollution of the Clark Fork River, and will service a population of 50,000. Its construction is unique, since it is located at a former landfill site. The plant was designed so that future secondary treatment can be accomplished with minimal change of existing facilities. It is a conventional primary type plant with clarification, chlorination, two-stage digestion and sludge drying beds. The plant design and operation are described in detail and a flow diagram illustrates how the effluent from clarifiers doubles back through the chlorine contact tank located below grit channels and a Parshall flume. The cost of operating the plant is estimated at $57,700 per year.

**64-0878**

Grouting a refuse fill. Public Works, 95(7):133, July 1964.

Two adjacent blocks of post-war flats in England were found to be partly over the edge of a quarry, which had been filled in 1925 with household refuse, and subsequently topped off with 5 ft of clay. The flats were founded 2 ft into the clay and had settled at their adjacent ends by 6 in. and 8 in. respectively. It was decided to undertake pressure grouting to correct the situation. A line of 2 in. primary treatment holes at 6 ft centers was drilled down to the rock on the quarry side of the blocks. Cement per sand grout was then injected through the drilling rods as they were slowly withdrawn, in order to form a wall of grout under the quarry side fittings. The pressures employed rarely exceeded 10 lb per sq in. Injection continued under the remaining footings, secondary holes being drilled and injected to tighten up between the primaries and ensure support under the whole of the blocks. Toward the end of the injection, pressures developed were of the order of 25 lb per sq in. A total of 66 tons of cement and 37 tons of sand were injected. The work was completed in March, 1962. Dump-level readings taken since show that there has been no further settling.

**64-0879**
Hansen, D. From missile base to sanitary landfill. Western City, 40(9):68, Sept. 1964.

The land which Dixon, California, had used as a dump was needed for expansion of the sewage treatment plant, and it needed another site. The Department of Health, Education, and Welfare donated 20 acres of the former missile base to the city. A 6-ft fence surrounded the site as was required, and Arizona cypress trees were used as screening along the road way. Because the launching pad foundations were so strongly built, trenches were excavated parallel to and between rows of pads. After all the available land is crossed with parallel trenches and filled, enough time will have elapsed to decompose most of the refuse in the first area used, and the area can be cross-trenched, thereby making maximum utilization of the land.

**64-0880**
Honolulu plans 1,000 yard daily landfill. Refuse Removal Journal, 7(9):30, Sept. 1964.

A study of the nature of solid wastes generated in Honolulu prompted a recommendation for a landfill capable of accepting at least 1,000 cu yd of refuse daily and a special incinerator to handle refuse high in moisture.

**64-0881**
Johnson, W. H., and B. F. Bjornson. The sanitary landfill training guide. Atlanta, Ga., Communicable Disease Center, U. S. Public Health Service, 1962. 20 p.

The sanitary landfill is an effective, proven method for the permanent disposal of refuse. It is especially suited for, and commonly used for, cities of less than 100,000 population, because land is usually available. The preliminary considerations for operation of a sanitary landfill include proper selection of site, proper design and operation, and strict adherence to sanitary landfill standards to preclude operational problems or public objection. Site requirements, land requirements and length of haul, equipment needed, personnel, and additional facilities are considered. The operation of the sanitary landfill, with specific recommendations for areas level, on a slope, in low swampy areas, and in valleys and ravines are detailed and illustrated. Problems raised by operation in a small community, in winter or in inclement weather are considered. A list of recommended practices is given with details for operation. A comparison of sanitary landfill and incineration as methods for refuse disposal is given and the advantages and disadvantages of sanitary landfill are listed. Selected references and a list of audio visual aids from the communicable disease center are included.

**64-0882**
Kaupert, W. The present method of dumping waste. Staedtehygiene, 15(4):77-80, Apr. 1964.

Important criteria for dumping waste are reviewed. For new disposal sites a permit must be obtained from local authorities; it has become very difficult to find new sites. When domestic waste is dumped, it should be done in layers not exceeding 2 m in height, and compacted, and covered with a layer of finely milled or homogenized waste, upon which a new layer of waste can be deposited. Very often waste is dumped into deep pits and compacted so tightly that no oxygen can penetrate, in which case the rotting process is greatly slowed down. For instance, in a 5 1/2 m pit, the waste was decomposed only down to 4 m after 23 years. The bulldozer has become indispensable at disposal sites. Compacting prevents breeding of rats and insects within the waste. (Text - German).

**64-0883**
Ligouri, F. R. Open dump can be operated without hazard to the public. Refuse Removal Journal, 7(1):27, Jan. 1964.

The problem of maintaining safe open dumps, particularly in small towns and rural areas is discussed. Some steps recommended are isolating the dump from sensitive land areas, effectively using rodenticides at regular planned intervals, dumping at only relatively small areas at one time, and covering the rubbage with earth. If necessary, communities could also share the same bulldozer.

**64-0884**
Maily, H. V. Landfill from eyesore to asset. Public Works, 95(11):95-96, Nov. 1964.

Wilkes-Barre and three adjoining Pennslyvania communities joined together to convert 60 acres of an abandoned coal stripping operation, leased at $1.60 annually, into a centrally located sanitary landfill. Estimated annual expenditure for operation on a five-day week basis was $36,340 or $.39 per capita. In June, 1964, 3,747 vehicles used the site. Charges are made according to vehicle size. The site is worked 10 hr per day, 6 days per week. Salvaging is discouraged. Burning and scavenging are prohibited. It cost the East Side Landfill Authority $2,000 to prepare the site. A 2½ cu yd crawler tractor and a loader were purchased, costing $30,000 each. The cost to Wilkes-Barre of operating its 30-year old incinerator had increased from $20,000 in 1937 to $60,798 in 1963. Since the landfill operation costs less than $25,257, the city will save $35,000 each year. Officials are considering using the old incinerator to store bulk rock salt.

**64-0885**
Measuring gas escape from a landfill. Public Works, 95(9):163, Sept. 1964.

To measure the rate of carbon dioxide escape through a 1 ft silt cover over a landfill, special equipment was designed by Engineering Science, Inc. An airtight box 4 ft x 16 ft x 8 in. was laid flat on the fill surface. The box, open on the flat side down, confined the volume over a given surface, thereby confining any gases escaping upward from the fill beneath the box. The confined mixture of gases was swept out of the box by slow induced air movement produced by a small pump located on the downstream end of the box, which drew air into four ports on the upstream end. The four inlet ports were galvanized pipes stuffed with copper wool saturated with potassium hydroxide for removal of any carbon dioxide in the incoming air. After passing through the box and sweeping the ground surface, the gas mixture passed through caustic potassium hydroxide to absorb the carbon dioxide. Weight gain of absorbers, over a timed run, represented carbon dioxide collected. From theoretical diffusion equations it had been estimated that 1.2 x 10 to the sixth power lb per acre per year of carbon dioxide were escaping upward to the atmosphere. The direct measurements, with the above described monitoring apparatus, showed that the amount was less than this by a factor of 6.3 times. Further test incorporating several refinements are planned.

**64-0886**
Merz, R. C. Determination of the quantity and quality of gases produced during refuse decomposition; second annual report. Los Angeles, University of Southern California, July 1963. 31 p.

The second annual report contains a review, summary and interpretation of all work completed since December 1, 1961, the start of the investigation. The results of the laboratory studies, conclusions, the laboratory procedures, and a discussion are presented. Supporting data and numerous illustrations are offered. Eight 55-gal steel drums were used as containers for varying amounts of refuse and the gas production was measured against time and temperature. The gases were analyzed. The temperature in all drums rose 10 to 14 F when the room temperature was maintained between 90 and 95 F. The volume of gas produced, as expected, is related to the grass and garbage content of the refuse; gas production in one drum was higher than two others under comparable conditions. The volume of gas produced is apparently related to aeration; gas production was higher in the aerated drum that those which did not receive air. Carbon dioxide and nitrogen have been the major gases found in the drums. Carbon dioxide, except for one drum, has consistently increased in volume since the start of the investigation. Methane, except for minor amounts in one drum, was not found in measurable volumes in the drums--even that which was saturated.

**64-0887**
Merz, R. C., and R. Stone. Factors controlling utilization of sanitary landfill site; final report. Los Angeles, University of Southern California, 1963. 126 p.

A three-year study of the factors controlling the use of a sanitary landfill site is reported. The optimum means by which the most waste can be put into the available volume and at the same time permit shrinkage prediction was determined. Six test cells, each 50 ft by 20 ft deep, were constructed at the Spadra Landfill, Walnut, California, by the County

Sanitation Districts of Los Angeles County, a cooperating agency. The conditions of construction of each cell were varied, and their influence on the biochemical decomposition of the organic material was studied. The planning and execution of the field installation, the data obtained concerning cell construction, shrinkage, gas production, temperature and humidity, and conclusions drawn from the data are detailed. Numerous illustrations and charts are presented.

**64-0888**
Merz, R. C., and R. Stone. The sanitary landfill site. In Factors controlling utilization of sanitary landfill site; final report. Los Angeles, University of Southern California, 1963. p.6-9

The site chosen was that offered by the County Sanitation Districts of Los Angeles County, known as Spadra Landfill No. 2, located near the City of Pomona, California. The site covers 128 acres and serves approximately 180,000 persons. It was established in 1957. The area finally selected was a former walnut grove. Preparation of the site on which the test cells were to be constructed included clearing away of the walnut trees, excavation of the cells, placement of access wells, and installation of the facilities and instruments required before placement of refuse. A trough 50 ft wide by approximately 500 ft long by 9 ft deep was first excavated. The result was an in-line series of five cells having the appearance of a series of truncated pyramids. Cell 6 was scheduled for full construction above ground. In the center of each cell there was erected an access well to provide outlets for gas collection lines, leach collection lines, and electrical leads, and a means of human access for placement of test samples and equipment as well as the taking of internal humidity and temperature measurements. Each access well consisted of a steel pipe 44 in. diameter by one quarter in. thick by 18 ft long, with numerous openings cut into the side. To eliminate the possibility of loss of water through ground seepage in cell 1, the bottom was fully covered with a seamless, impervious, polyethylene membrane having a thickness of 6 mm.

**64-0889**
Merz, R. C., and R. Stone. Refuse and soil. In Factors controlling utilization of sanitary landfill site; final report. Los Angeles, University of Southern California, 1963. p.9-13.

All of the refuse places in the six cells originated in the residential districts of the adjoining communities of Pomona, San Dimas, Claremont, and LaVerne. Further control was exerted to make certain that only typical domestic refuse consisting of paper, grass and garden trimmings, garbage, and miscellaneous inert material was placed in the cells. Industrial wastes were excluded. The solid waste, as finally placed in the cells, consisted of approximately 65 percent paper, 25 percent grass and garden trimmings, 5 percent garbage, and 5 percent inert, by volume. In the laboratory, the average moisture content for the entire mass of refuse was determined to be 35 percent on a wet weight basis (54 percent dry weight basis). The top soil of the entire Spadra site comprises a thin layer of organic loam. It was skimmed off and stockpiled for use elsewhere. The subsoil consists of a decomposed shale. It is this material which was used for the buffer strips, for admixture with refuse, and for final cover on the top and sides of the cells.

**64-0890**
Merz, R. C., and R. Stone. Cell construction. In Factors controlling utilization of sanitary landfill site; final report. Los Angeles, University of Southern California, 1963. p.13-39.

The six cells were built with an overall depth of 20 ft. The first five cells were begun approximately 9 ft below normal ground elevation, whereas cell 6 was built entirely above ground. In cell 1, the refuse was placed continuously until full depth (18 ft) was reached. As the refuse was being placed, it was continually watered to refusal so that the overall cell moisture content was 80.1 percent on a dry weight basis. In cell 2, the refuse was placed in 4-ft thick layers separated by 1-ft thick earth covers. Sufficient water was added to bring moisture content to 43.5 percent. In cell 3, the refuse was placed in 4-ft thick layers separated by 1-ft thick earth covers. No water was added. In cell 4, the refuse was placed continuously until full depth was reached. Water was added to a moisture content of 51.9 percent. A 2-ft thick top cover was added to bring the overall depth to 20 ft. In cell 5, earth was admixed with the refuse in the ratio of 1 part earth to 2.2 parts of refuse by volume. Water was added to moisture content of 34.8 percent. A 2-ft thick cover was used. Cell 6 was built entirely above ground in a manner that would admit the atmosphere into the interior of the cell. Refuse was placed and water was added to a moisture content of

89.9 percent. The compaction ratios achieved are tabulated. Various measuring instruments are set in place. As the cells were constructed, half sections of 55-gal steel drum were located within the cells, 2 with open end up for the collection of leach and 2 with closed end up for collection of gas.

**64-0891**

Merz, R. C., and R. Stone. Cell activity. In Factors controlling utilization of sanitary landfill site; final report. Los Angeles, University of Southern California, 1963. p.39-83.

Data indicate that the greatest settlement has occurred in aerobic cell 6; in the anaerobic cells maximum settlement has occurred in cell 4. Cell 4 was constructed with minimum compaction. Total settlement figures are presented. During the first two weeks following completion of construction, the aerobic cell surface has the greatest rate of settlement, 7.18 ft per month. This was followed by the minimum compaction cell 4, 3.42 ft per month, with cells 3, 5, and 2 following in that order with much the same rate of settlement, approximately 2.25 ft per month. Cell 1 had the lowest rate of settlement, 1.23 ft per month. In the fifth month, there was only a difference of 0.05 ft in the rates of settlement between minimum and maximum values. The gases collected within the inverted collection cans, the leach collection cans, the DWR tubes, and the surface collection can, are described and the access wells were analyzed. A review of the data shows a general trend of the gas components, except methane, to fluctuate with time. The methane component appears in increase with time. In general, a peak temperature was reached at each level relatively soon following completion of construction of the cell. However, in some cases, a further slight increase in temperature occurred with passage of time. Some odor problems were encountered during construction in the uncovered cells, the most severe being in connection with the saturated cell. The odor disappeared with the covering of the cell.

**64-0892**

Merz, R. C., and R. Stone. Supplemental studies. In Factors controlling utilization of sanitary landfill site; final report. Los Angeles, University of Southern California, 1963. p.83-93.

Two preliminary and parallel phases of the work were carried out. One was a literature survey, the other was visitation of other landfills to learn their operating procedures. Operating landfills visited included: San Diego, California, and Phoenix, Arizona, where water is being admixed refuse; Fresno, California, where compaction is being employed; San Francisco, California, where the effect of tidal water is being observed; Burbank, California, where data on landfill settlements are being secured; and the City of Los Angeles, Griffith Park Landfill where a pressure plate is being used to measure refuse weight. The general qualitative information thus obtained was employed to develop the test cells. The records of more than 1500 trucks were examined and the maximum and minimum densities were determined. Time studies were made to find out how long it took to unload the compactor type truck of the refuse it carried. Experiments were carried out to indicate whether or not the amount of water needed to support the life of grass and selected shrubbery on top of a landfill site would be enough to cause percolation through a known depth of landfill. A study was made to determine the effects of moisture and temperature on refuse combustion, and a safe moisture percentage limit above which refuse will not spontaneously burn. The procedure is described.

**64-0893**

Ministry of Housing and Local Government. New life for dead lands--derelict acres reclaimed. London, Her Majesty's Stationery Office, 1963. 30 p.

In England and Wales there are about 150,000 acres of derelict land, much of which could either be reclaimed for development or improved. With the recent development of earth moving machinery, huge quantities of spoil and waste material, plus the progress attained in the technique for 'making soil', derelict land reclamation has become economically feasible. As a preliminary, colliery waste must be tested for presence of toxins. Shale often contains large amounts of sulphates, which can be toxic to plants, thus causing restricted plant growth. As colliery waste weathers, it becomes greatly acidic. Newly dug soil may be neutral, but this condition is only temporary. When the pH reaction is lower than 4.5, three tons of ground limestone per acre will usually remedy the calcium deficiency if applied prior to any organic matter. The application of an organic fertilizer before cultivation is essential. A compound fertilizer with a high potash content should be used. The optimum rate of seeding appears to be about 65 lb per acre. A bibliography is included.

**64-0894**

Moveable steel 'face' to refuse tip at Aldershot. Chartered Municipal Engineer, 91:103, Mar. 1964.

The steel barrier used to replace earth on the refuse tip at Aldershot is described and illustrated. The Borough Engineer's staff at Aldershot designed a steel barrier or moveable 'face' for the refuse tip to save money on earth cover. The barrier made of mild steel plates 8 ft square and 1/4 in. thick are fixed to a 4 in. channel frame at an angle corresponding to the tip face, with the lower legs of the frame acting as skids or runners on which the barrier can be slid forward as required. The barrier, which is held in position by the weight of refuse on the skids, is pulled forward each day to provide space for that day's tipping. The need for earth cover on the working face is obviated by leaving the barrier or face in position at the end of the day. A method is given which eliminates the need for earth cover in a tip according to the Borough Engineers.

**64-0895**

New tire for earth-moving machines. Public Cleansing, 54(2):722, Feb. 1964.

The new Mitio Duratrak pneumatic tire cannot be punctured from landfill operations. It is built up of radial laminated segments of rubber and fabric. A special renewable traction tread can fit over the tire for use on soft ground, which thus would render the life of the tire indefinite. The tire costs 50 percent more than equivalent pneumatic tires.

**64-0896**

Osborn, V. New equipment cuts landfill costs. American City, 79(7):27, July 1964.

By replacing a 7-year-old truck-type loader with a new machine that has a guaranteed maintenance provision, Springfield, Missouri, will save an estimated $[illegible],780 on sanitary landfill costs during the next 2 years. The city accepted the bid offered by the local Caterpillar dealer for a 955H loader, with a proposed maintenance cost of $3,500. Under terms of the maintenance contract, the dealer furnishes all labor and material necessary (excluding normal wear items) to maintain the loader in good operating condition. The dealer serviceman makes a monthly inspection, and a suitable replacement machine must be supplied during prolonged repair, but the contract guards against unjustified service calls. The new machine has a 1 3/4 cu yd multi-purpose bucket which is particularly useful in landfill work. The 955H's primary duty consists of spreading and compacting refuse on the trench slope, then spreading cover dirt.

**64-0897**

Pagan, R., and C. H. Billings. Soil-cement road on marshland. Public Works, 95(5):93, 94, May 1964.

In order to reach a new landfill area in the Borough of Rutherford, a new, inexpensive roadway had to be constructed by the State of New Jersey across Berry's Creek. At the site of the crossing the creek bed was about 150 ft wide and the distance from the creek bank on the landfill side to the highway access road was about 520 ft. It was decided to construct a sub-base using borrowed fill to support a soil-cement base road. The embankment construction and the construction of soil-cement base road are described in detail. The final cost of the job totalled $70,000. The actual cost of the surface was $6,818.75 or $2.73 per sq yd. The road was used throughout the winter of 1963 to 1964, taking a traffic load of about 100 loaded trucks per day. The surface remained unbroken and otherwise in good condition. Considerable deformation of the original contour and some settling have been observed, but these imperfections have not detracted from the overall usefullness of the structure and it is anticipated that the road will last at least the life of the fill area.

**64-0898**

Pagano, S. Sanitary landfill operations in New York State. Public Health Reports, 79(6):543-548, June 1964.

Sanitary landfills are operations in which refuse is neatly deposited in the ground, compacted, covered daily with 6 in. of earth, and compacted again. Modified landfills fail to meet the last two requirements. This disposal method is gaining popularity, especially since it can be operated inexpensively in many terrains. Sanitary landfills were made requisite in New York in an attempt to solve the state's vast refuse problem. This discussion considers the results of a 1962 survey of 24 newly-installed operations. The investigation indicated that the cost per person of running landfills generally decreases with increasing population. Cost itself depends upon price and availability of land, labor, machinery, and the number of working hours. Inefficient operation, poor site location, and heavy clay soils incur high expenses. Crawler-tractors with front-end loaders are the most widely used equipment. The ideal cover material for landfill operations is a half sand, half clay-silt soil. Stockpiled cover material should be covered with vegetation, straw, etc., to keep it relatively dry. The number of working hours for landfills depends on the number of the population served, varying from 8 to 64 per week. Burning at sites is undesirable, resulting in pollution. Fire, blown papers, odors, and rodents are the only major problems experienced. Small communities may meet economic problems by banding together for landfill operations. Once operations cease, no future use for sites is generally planned. Additional data discusses all aspects of the survey taken.

**64-0899**
Partridge, J. W. Disposal of solid waste in rural areas. In Proceedings; Second International Congress, International Research Group on Refuse Disposal, Essen, Germany, May 22-25, 1962. p.1-17.

The main rules to be observed for controlled garbage dumping are: (1) garbage is dumped in successive layers of moderate thickness; (2) the layers are levelled and limited by banks of less than 45 degrees; (3) dumping must be compact; and (4) the dumped material must be covered on the same day with at least 4 in. of earth. In practice, however, many difficulties arise from controlled dumping. The various problems are discussed, such as, garbage transformation process, temperatures, thickness of the dump, and covering of the dump. It is preferable to use a heavy vehicle working rapidly, such as a loader, a bulldozer and a packing grab. Tightness of the cover layer is a favorable factor in fire control. Methane gas might cause accidents if it penetrates into the cellars of neighboring houses. Whenever methane is present, the heap is too high, too packed, or was covered up with a fresh layer too quickly. Destruction of insects and rats is one of the aims of controlled dumping. Common pests are flies, crickets, and rats. Surveillance is required, and current types of pesticide are to be applied. Once completed, dumping grounds can very quickly be turned into meadows and cultivation areas, as well as public gardens and sport grounds.

**64-0900**
Pound, C. E. Our landfill plays favorites. American City, 79(1):85, Jan. 1964.

A county landfill encourages municipal sanitation departments to incinerate their refuse before burial. Three truckloads of raw refuse condense to one truckload after incineration. Because of limited landfill sites, a $2.25 per ton disposal fee for raw refuse against $1.75 per ton for incinerated refuse was instigated, allowing savings for incineration by sanitation departments of 25 percent. The proposed switch to rubber wheels from track vehicles for better compacting is also explained.

**64-0901**
Refuse tipping and land reclamation. Surveyor and Municipal Engineer, 124(3784):37-38, Dec. 12, 1964.

Bristol's refuse tipping and land reclamation program is described as one manner of dealing with disposal problems. Separation of household waste from industrial waste is mentioned, as is the increasing amount of plastic and polythene which does not break down and which stops circulation through the tip. Workable tipping sites reasonably close to the city and located where serious objections would be unlikely are becoming scarce. Underground streams and other watercourses pose a problem. Pulverization, incineration, tipping into the sea and other methods are mentioned as alternative solutions.

**64-0902**
Regional recovery of derelict land. Surveyor and Municipal Engineer, 124(3779):52, Nov. 7, 1964.

The advantages of the disposal of refuse by dumping are discussed in reference to the recovery of unusable land. While some heavily urbanized areas require the use of mechanical means of refuse disposal, disposal by dumping can be more economical and contribute to land reclamation. It is estimated that there are 12,000 acres of holes in the ground which should be filled in Britain. This land spoilage is increasing at the rate of 3,500 acres a year. In South Lancashire, which has one of the largest areas of land requiring fill, there is also a problem of disposal of waste and refuse. The proper location of transfer stations should reduce the costs of refuse collection haulage and allow the bulk hauling at costs of 5 to

10 shillings per ton depending on the distance. The future requirements for waste disposal must be coupled with an estimate of the production of land made unusable by holes to make certain that alternative means of disposal are available before the saturation point is reached.

**64-0903**
Sanitary landfill use studies. Public Works, 95(4):24, Apr. 1964.

A 3-year study of the factors controlling the use of a sanitary landfill site has been completed by the University of Southern California. The purpose was to determine the means by which the most waste can be put into the available volume and at the same time permit shrinkage prediction. Six test cells, each 50 ft square and 20 ft deep, were constructed. The conditions of each cell were varied, and their influence on the biochemical decomposition of the organic matter was studied. Reports on two phases of the work were carried in Public Works, in September 1961, and February 1964, respectively. A final report details the planning and execution of the installation, documents the data concerning cell construction, shrinkage, gas production, temperature and humidity, and presents conclusions. Copies of the report are available from the Department of Civil Engineering of the University of Southern California.

**64-0904**
Sanitary landfills. Canadian Municipal Utilities, 102(12):18-22, 50-52, Dec. 1964.

Interviews with Mr. Charles Newbury, a consultant and scientific adviser in pollution and hygiene, stress the serious disadvantages of sanitary landfills: (1) if not properly covered in, there are odors and rats which make the landfill unsightly and lead to health hazards; (2) because of the gases generated, mainly methane, sanitary landfills cannot be used to build upon for 40, or maybe even 100 years, unless expensive precautions are taken; and (3) the use of ravines for sanitary landfills destroys the natural landscape. He feels that the solution lies in more extensive use if incineration as a means of garbage disposal with a combination of incineration plus landfill for burying the ash, as well as the development of other uses for ash. Mr. Ian McKerracher, an engineer in charge of sanitary landfill operations in Toronto, feels that although there has been some trouble, it has not been great enough to indicate that landfills are not the best way to dispose of garbage. He indicates that there really is not an alternative since incineration still leaves 50 percent of the refuse, which then has to be buried, and since it is no longer acceptable because of air pollution. Incineration to the point where the material is inert is tremendously expensive. Some of the problems facing sanitary landfill operations are leaching methane gas production, the proper amount of cover to use, and the ability to plant on the lan

**64-0905**
Shall we bury refuse or rocket it into space? Refuse Removal Journal, 7(8):8, Aug. 1964.

Four methods are currently used to dispose of refuse on land: open dumping; controlled burning dumping; refuse filling; and sanitary landfilling. The trend is toward the sanitary landfill, of which there are basically two methods: the trench method and the area method. Factors to be kept in mind in planning and operating the sanitary landfill are listed.

**64-0906**
Two county groups sue for landfill site. Refuse Removal Journal, 7(1):28, Jan. 1964.

The Bergen County, New Jersey, Board of Freeholders, and a group of several Essex County communities will try to initiate condemnation proceedings against the Erie-Lackawanna railroad in Bergen Superior court. Both plaintiffs want to purchase railroad-owned land for use as a garbage disposal site. They have offered prices up to $1,000 an acre, but have been refused without explanation.

**64-0907**
Vanderveld, J. Design and operation of sanitary landfills. In American Public Works Association Yearbook. Chicago, American Public Works Association, 1964. p.242-246.

The need for proper selection of landfill operation sites and the need for experienced personnel to design the entire operation from beginning to completion of the project are discussed. This includes preparing the necessary technical data such as topographic maps, geology, soil characteristics, plans and specifications, and other design features, and spelling out in detail the complete operational procedures to be followed. An important factor in getting the public to accept the sanitary landfills is good public relations operations. Public relations operations in Waukegan, Illinois, are discussed. A plant in Florida handles 50 tons of refuse each day. Research methods have been perfected for mixing and treating sewage and refuse and converting this to an outstanding and useful fertilizer.

**64-0908**
Versatile land-rover. Public Cleansing, 54(9):1167, Sept. 1964.

Ripen and Pately Bridge, England, has brought a Land-Rover vehicle with a dozer blade and a refuse collection type body, which provides the versatility necessary for a rural area with six scattered tips. The vehicle spreads and compacts the refuse at the tips, tows other vehicles that have broken down, and hauls refuse from premises where normal packers cannot reach because of narrow and badly surfaced roads.

**64-0909**
Want railroad site for dumping area. Refuse Removal Journal, 7(11):20, Nov. 1964.

Since Newark, New Jersey, is facing an impending shortage of refuse disposal areas, the city is taking legal action to foreclose on 39 acres of meadowland railroad property for back taxes. It intends to use the area for landfill operations. If the action is successful, the benefits will show up immediately in the refuse collection budget, as not all of the collection trucks will have to make the long haul to the small town dumping site now being used. It is planned to divide the city into two collection zones. The refuse from one zone will be delivered to the railroad area site, while the collected material from the other zone will be carted to the out of town location. Long range plans for the proposed new landfill area are to fill, develop, and then sell the land for industrial construction. Both composting and incineration was studied by the city, but it was decided to continue the landfill system.

**64-0910**
Weaver, L. Refuse disposal, its significance. Ground Water, 2(1):26-30, 1964.

Whenever refuse is deposited on land, the potential impact on surface water or subterranean aquifers by leaching may be significant. A good site selection can eliminate many problems. If leaching of a landfill does occur, it has been shown that ground water in the immediate vicinity can become grossly polluted and unfit for domestic or irrigation use. Ash dumps were shown to leach soluble salts and alkalies to the extent of 2.9 lb per cu yd for cations and 5.3 lb per cu yd for anions. The deeper aquifers can be protected from pollution by their own impervious layer; however, this does not protect it from downstream pollution and subsequent travel of chemical pollutants to its present location. Data now available indicate that the pollution of ground water from a refuse source has been essentially limited to shallow aquifers, but that deeper aquifers can be affected. Those landfills that are not class 'A' operations pose the most cause for concern. We need to know much more about both geological and climatic characteristics that, along with operational techniques, are so important to short- and long-term effects of degradation, and to possible leaching of refuse disposal on land.

## STREET CLEANING

**64-0911**
Annunziata, A. Flushers fill the gap. American City, 79(5):8, May 1964.

Previous flushing with water improves cleaning efficiency on streets in Mount Vernon, New York. Flushing washes refuse to gutters where it can be easily collected.

**64-0912**
Billings, G. D. The pros and cons of vacuumized sweeping. In American Public Works Association Yearbook. Chicago, American Public Works Association, 1964. p.180-184.

A brief history of vacuumized sweeping is presented. One argument for vacuumized sweeping shows that it provides effective dust control, and some units make it possible to trap dust particles as fine as five microns in size smaller than the human eye can see. All of the world's leading automobile plants--Rolls Royce, Cadillac, General Motors, Fiat, Volvo, Chrysler, Volkswagen and others have used American-developed vacuumized sweeping for many years. Argument against vacuumized sweeping shows that it is limited to relatively smooth paved surfaces. While there is reasonable tolerance of an inch or so with a vacuumized sweeper, it is obvious it won't work on cobblestones at all. A brief explanation is given of some of the tests the manufacturers run the sweepers through, to improve on the performance and maintenance of these units.

**64-0913**
Bredell, R. G. 'Unkempt, unswept' label touches off a storm. American City, 79(10):114-115, Oct. 1964.

Seventeen years ago a book entitled 'Inside U.S.A.' by John Gunther criticized the sanitation of Indianapolis, Indiana. In retaliation, the city began a clean-up campaign which has won them many civic honors. The campaign was assigned the name 'Yard Parks' and began in 1949, but in 1955 the first signs of real results appeared. The Board of Public Works, Street Division stepped up efforts to maintain and improve streets and curb areas. The project, according to the article, would never have gotten off the ground without the help and drive of the citizenry.

**64-0914**
Bristling with possibilities. Public Cleansing, 54(3):805, Mar. 1964.

Burnley, England, has experimented with polypropylene bristle on both manual and mechanical sweeping. This has resulted in a more efficient sweep. It improves the resilience of the natural bristle.

**64-0915**
Danforth, H. L. Follow-up sweeper vacuums up dirt. American City, 79(5):8, May 1964.

Use of small, hand-pushed vacuum cleaners on wheels to pick up janitor cleanings from business buildings which are dumped in gutters after regular street sweeping has improved downtown appearance in Tucson, Arizona.

**64-0916**
Denison, R. E. Methods of evaluating street cleaning programs. In American Public Works Association Yearbook. Chicago, American Public Works Association, 1964. p.153-157.

Twelve ways to assist in measuring the adequacy of effectiveness of community street cleaning programs are listed. Problems in the city of Baltimore are discussed. The biggest weakness is the failure of the city to provide effective control over the parking and storing of motor vehicles on the streets. This has severely limited the street sweeping potential, since the force of ten sweepers is largely operating on arterial streets only.

**64-0917**
Edwards, R. A. One flusher for two cities. American City, 79(6):30, June 1964.

Two Maryland cities, College Park, population 21,000, and Cheverly, population 6,000, jointly purchased a flusher to clean their streets. Its use is proportional to their respective $8,000 and $4,000 investments.

**64-0918**
Esso T. Let the rain help you sweep. American City, 79(6):30, June 1964.

Metuchen, New Jersey, uses rainy days to put otherwise task-less men out assisting sweeping. The rain softens and holds down dirt, the sweeper doesn't have to stop for water, and a truck and loader are available during inclement weather.

**64-0919**
Fleming, R. R. How sweepers really perform. American City, 79(5):113, May 1964.

Results of the magazine's street cleaning survey of large and small American cities are reported. The report contains information on sweepers vs. population and street mileage, sweeper performance and life, mileage of brooms of various natural and synthetic materials, and frequency of sweeping streets of different areas. The survey also includes the most pressing problems and the most appreciated recent development in street cleaning.

**64-0920**
Haley, J. W. Hokie-pokies can't compare. American City, 79(3):26, Mar. 1964.

In Boston, Massachusetts, two 53-in. path vacuum sweepers have replaced six men using pushbrooms and carts. This mechanization, in traffic-congested areas where big sweepers cannot operate, has proved to be both efficient and economical. The small Tennant 88 vacuum sweepers, which patrol daily, can control dust without using water. They dump their loads at selected points for later pick-up by a loader and truck.

**64-0921**
Hickok, R. How to cut street-cleaning costs. American City, 79(7):90, July 1964.

The street superintendent of El Paso, Texas, outlines the new policies and equipment that he has introduced for street cleaning and the consequent improvement over hand labor.

**64-0922**
Keeping the streets clean. American City, 79(7):14, July 1964.

In Chicago, Illinois, mechanical sweepers cleaned 109,391 curb miles of streets, and hand labor swept an additional 60,209 curb miles during 1963. To aid the 100 sweepers, which the city has in operation, 2,400 vivid plastic litter baskets were added to 12,600 others conveniently placed at strategic locations. It is anticipated that the attention-attracting colors of these new baskets will encourage the public to toss their litter into them, instead of dropping it into the streets.

**64-0923**
Lucia, F. J. If it works in New York City. American City, 79(1):100, Jan. 1964.

Major street-cleaning practices and problems in New York are discussed. This city uses alternate-side parking bans to facilitate gutter cleaning in areas with many parked cars both day and night. Problems of fall leaf removal and vacant lot clearance are considered. Replacing wood and natural fibres with plastics fibres in machine sweeper brushes extends life ten-fold. Training operators in the adjusting and use of the expensive brushes was also initiated.

**64-0924**
McElwee, W. Sweeping crew shrinks to one man for two units. American City, 79(7):14, July 1964.

One operator takes care of the entire sweeping and hauling tasks for Muscatine, Iowa, a city of 22,000. Near the end of the day he exchanges the sweeper for a self-contained Lo-Dal loader to clean up the piles previously dumped onto the street. This system eliminated two trucks, a loader, and four men. However, this method is somewhat slower and needs supplementing during the early part of spring cleanup and for leaf pickup late in the fall. The driver covers about 20 curb-miles during each 8-hr shift, and the bass-filled brooms run about 175 miles before they need replenishing.

**64-0925**
Ministry of Housing and Local Government. Public cleansing refuse collection and disposal; street cleansing costing returns 1961-62. London, Her Majesty's Stationery Office, 1963. 58 p.

Public cleansing costing returns covering the year 1961-62 are compiled from returns submitted by local authorities of large urban areas and a number of selected rural areas in England and Wales. Collection and Disposal of House and Trade Refuse, and Street and Gully Cleansing are the two main areas discussed. Tables compiled on house and trade refuse cover: Amounts Collected per 1,000 of population; Collection and Disposal-Unit Costs; Range of Costs; Costs per Ton-Collection; Costs per Ton-Disposal; Costs per Ton-Labour and Transport; Salvage; and Figures for Individual Authorities. One table on Figures for Individual Authorities is presented for Street and Gully Cleansing.

**64-0926**
Modern vehicles and equipment in Germany. Public Cleansing, 54(6):945, June 1964.

Papers on refuse collection vehicles in Frankfurt, Germany, and street cleaning vehicles in Hanover are reviewed. Frankfurt heavily employs mechanical and dustless loading. The Hanover paper discusses large mechanical sweepers which can be converted for other uses.

**64-0927**
Municipal techniques--'Sanitary Sam' in Chula Vista. Western City, 40(3):44, Mar. 1964.

In addition to their regular street cleaners, the people of Chula Vista, California, have

'Sanitary Sam'. He is a unique figure, who travels through the business and residential districts, picking up trash and debris that has accumulated since the regular street cleaner made his rounds. 'Sanitary Sam' wears a white uniform and travels on a white three-wheel scooter which houses an extra large trash can, broom and shovel. At Chula Vista, 'Sam' is part of the free civic betterment program and is accepted warmly by the people. There has been no copyright placed on 'Sam', since it is hoped that more cities will take advantage of the idea.

**64-0928**
New development in gully emptying. Public Cleansing, 54(2):724-725, Feb. 1964.

Some features of a new gully emptier, the Dennis, developed in England, are a scientific method to test range of vision, optional left-hand steering for better control of curbside cleanup, optional power jets for washing beneath parked vehicles and flushing debris into the gutter, and pressure spraying equipment at the front end of the vehicle.

**64-0929**
New vacuum train cleans New York transit system. Refuse Removal Journal, 7(4):18, Apr. 1964.

New York City has acquired a three-car vacuum cleaner, more than 150 ft long, to clean its subway tracks. It cleans from three to 10 miles of track per hr, depending upon the amount of debris present. A major feature of the new cleaner is that it will be completely protected against fires.

**64-0930**
Patrick, P. K. Mechanical street cleansing. London, Temple Press Books, 1964. 48 p.

Information and data on mechanical street cleaning was obtained from local authorities; different types and the machines available in England at the present time were surveyed. An effort was made to foresee future trends or developments. Subject headings include: Introduction, Types of Mechanical Sweepers, Selection and Operation of Mechanical Sweepers, Mechanical Sweeping of Footways, Economics of Mechanical Street Cleansing, Maintenance, and Conclusion. Two appendices give a classified summary of mechanical sweepers and suction cleaners and a record of brush wear on mechanical sweepers.

**64-0931**
Power sweeper cuts uneven broom wear. Refuse Removal Journal, 7(1):33, Jan. 1964.

A 4½-yd power sweeper for municipal use which is capable of highway speeds to 25 mph is described. Three brooms and conveyor speeds are provided and an improved broom suspension system is incorporated within the machine.

**64-0932**
Rheinfrank, W. J. Solving street cleanings toughest problem. American City, 79(4):94, Apr. 1964.

The Vacuum truck method of collection of street sweepings dumped along sweeper routes in Milwaukee, Wisconsin is described. Here two vacuum cleaner 16-yd closed collection trucks replaced crews hand-loading dumped sweepings into open trucks at 1/3 the cost of hand-loading.

**64-0933**
Rossi, R. M. A clean sweep costs more. American City, 79(6):114, June 1964.

The street cleaning procedures of Riverside, California, are described, including the use of night sweeping. Dust, palm fronds, and limbs resulting from high winds necessitate modification of manual cleaning systems.

**64-0934**
Stenman, A. Men and machines cut one third off sweeping bill. American City, 79(3):111, Mar. 1964.

Street cleaning procedures which cut costs from $4.68 per curb mile to $3 per curb mile in Fresno, California, are described. Route-and-procedure analysis with the help of drivers accounted for the savings. A service-rating system has improved the work of the men.

**64-0935**
Tope, O. Modern street cleaning vehicles and equipment of German Public Cleansing Department. Presented at Eighth International Congress of Public Cleansing, Vienna (Austria), Apr. 14-17, 1964. 28 p.

The objectives of and hindrances of public cleansing are discussed. Because of financial reasons, the shortage of labor, the high labor cost, and the need for obtaining maximum cleaning performance, mechanization of street cleaning has not yet achieved its full potential. For economy and sanitation, Heidelberg and Hannover 30 years ago, introduced system-bins for the reception of street sweepings. The sweepings are picked up by hand only once and are taken to a collecting point where the filled bins are emptied into special refuse collecting vehicles and exchanged for empty ones. An increase of sweeping performance and easing of working conditions was effected by introducing tricycles which were ridden like bicycles or driven by auxiliary engines, and which carry either two refuse bins of 60 liter capacity or one 110 liter bin. Vehicles carrying a crew of three and the number of bins required are also used. The development of light and efficient small engines resulted in a number of small sweeping machines which serve for sprinkling and sweeping as well as for gritting and snow plowing. Sweeping machines now in use feature disc-shaped side brushes which feed the sweepings to the brush equipped pick-up belt. A supply of water for sprinkling is available. Some of the machines are equipped with blowers to suck up the dust, and today, most of the pick-up sweeping machines use a suction device. The general requirements of sweeping machines are discussed. Special models developed for salt spreading are described. The removal of snow is becoming increasingly mechanized, using rotary snow plows, blower-type loaders, and shovel loaders. Thirty-seven illustrations of street cleaning vehicles with specifications are included.

**64-0936**
A truck-loading street sweeper. American City, 79(1):33, Jan. 1964.

Australian-designed street sweepers which can empty their hoppers directly into a truck were to be used in crowded Tokyo during the 1964 Olympics. At least 20 of the 5½ ton machines would be used. Hopper capacity was three cu yd, and sweeping widths were 7⅓ ft and 10⅓ ft with one and two side brooms, respectively. The machine can also discharge debris onto the ground if required. Design features include dual controls, broom adjustment from the cab, and simplified maintenance.

**64-0937**
Vacuum cleaner supplants brooms. American City, 79(7):14, July 1964.

A new vacuum cleaner with a yard-wide snout cleans the streets and gutters of Kitchener, Ontario, Canada more efficiently than was formerly done by brooms and carts. Powered by a 6 hp Briggs and Stratton engine, the Giant Vac costs $470.25, plus extra bags at $32.50 each. Each bag holds 11½ cu ft and one night's work in Kitchener fills about 1⅓ bags. The vacuum cleaner picks up everything, including bottles, without stirring up any dust. The steel impeller smashes the bottles to bits as it draws them in and a deflector prevents the resulting sharp slivers from piercing the bag.

**64-0938**
'We'll try anything...' Public Works, 95(9):118, Sept. 1964.

Since the Los Angeles County Highway Maintenance Department cleans close to 165,000 miles a year at a cost of $550,000 and wears out $50,000 worth of brooms, constant surveillance, record-keeping and experimentation is essential for good economy. A tachograph is mounted in each of the 47 sweepers operated by the county. This device records how far a sweeper traveled in a day, how fast it was driven, and how long the broom was functioning. These data permit analysis of the life of not only the machine and its components, but of the various brooms mounted upon it for experimental purposes. In addition, the operator files a daily report, explaining downtime, and reporting water consumption and contacts with property owners. The necessity for cost-keeping stems from the high increase in the cost of broom materials, which has risen from 8 cents per lb to as much as $3.50.

## LITTER

**64-0939**
Circus clown aids cleaner city drive. Refuse Removal Journal, 7(6):35, June 1964.

A 13-ft circus clown (on stilts) tossing litter into an oversized basket is another publicity gimmick for New York City's cleanup campaign. The Sanitation Department also plans to install 60,000 litter baskets throughout the city. The approach of the World's Fair prompted the drive.

**64-0940**
Kentucky fights litterbugs. Public Works, 95(10):103, Oct. 1964.

Kentucky's fight against litter along its highways is described. One of the state's weapons is a public relations program which includes meetings with clubs and service and civic groups.

**64-0941**
Land usage and litter. Public Cleansing, 54(6):970, June 1964.

On a recent train journey, it was possible to see how householders discard their unwanted belongings on another person's property. These actions suggest that those concerned are not utilizing their education. The common attitude seems to be that discards must be disposed of no matter what the eventual resting place. All people should educate themselves to keep tidy at all times. This would bring a silent revolution in the appearance of Great Britain.

**64-0942**
Litter clean-up out of the ordinary. American City, 79(4):34, Apr. 1964.

Two cities have different youth projects to aid general clean up. Portsmouth, Virginia, employed forty otherwise unemployed boys on a 40-hr week for the summer at $.50 per hr plus a $.25 per hr performance bonus. This cut down summer mischief and cleaned up the city. Pleasant Hill, California, lets juvenile traffic offenders work 6 hr on Saturday per $5 fine on roadside cleanup work. This allows the youth to pay for the offense instead of the parents.

**64-0943**
Litter left-and right. Engineering, 198:65, July 17, 1964.

A complaint against the indifferent attitude of the public toward the litter problem is discussed. An example is given to show some idea of the extent of the situation in the city, and indicates that it is worse in the country. Major offenders are paper refuse and unwanted cars abandoned on the street. The one suggested solution is to reduce layers of paper and cardboard packaging to a simple plastic wrapping.

**64-0944**
Littering of Jersey beaches is growing. Refuse Removal Journal, 7(8):12, Aug. 1964.

Problems New Jersey has in keeping its beaches clean are discussed. Some of the beach rubbish results from illegal dumping at sea.

**64-0945**
Paper sacks for holiday litter. Waste Trade World, 105(22):22, Nov. 28, 1964.

Holiday litter at caravan sites can be minimized by the substitution of a paper-sack system of refuse disposal for over-flowing dustbins. At the Crystal Palace (London), site of one of the largest caravan groups, the staff was unsuccessful in disposing of rubbish by burning, storing in 40-gal drums, and trampling in the dustbins. Their experiments with the Palfrey 'Refusacks' were so successful that the system was adopted all over Britain. The proprietors of several other caravan sites prefer the use of the 'Refusacks' because of the ease of handling compared to the heavier dustbins. It is possible to give each new arrival a fresh container regardless of the collection frequency and one sack holder will replace several dustbins that would only be used during peak holiday periods. The 'Refusack' system is suitable for all weather and is ideal for rush periods during Bank Holidays when the litter is the greatest and the collections are restricted because of limited staff.

**[illegible]-0946**
Polyethylene litter baskets. Plastics World, 22(8):19, Aug. 1964.

The City of Chicago has been using brightly-colored polyethylene litter baskets to clear the Loop area of unsightly trash. Citizens have given excellent acceptance and cooperation resulting in a cleaner city and substantial cost reduction in maintenance of old metal baskets. The baskets cost $10.50 each in comparison to $14.00 each for metal units. The baskets are 27 lb lighter than their counterparts, and there is an advantage in handling and storage, but there was a potential problem in considering Chicago's wind and cold. The problem was solved by riveting two 8-in. strips of metal, one on the inside and one on the outside bottom of each unit. Tests show the units to withstand wind forces of 35 mph. The units were clamped with a quick release clamp to utility poles.

**64-0947**

Tons of rubbish from the tinker district. Public Cleansing, 54(3):815, Mar. 1964.

Sanitation news from Birmingham, England, which includes a report on a clean-up campaign directed at the excessive litter in yards and gardens of a certain area of the city is reported. The litter was caused by overcrowding resulting from the immigration of Irish tinkers.

## HEALTH AND SAFETY

**64-0948**

Aaberg, H. C. Farmers and ranchers interest in zoonotic diseases. Continued Education Series 124. In Proceedings; Institute on Occupational Diseases Acquired from Animals, Ann Arbor, Mich., Jan. 7-9, 1964.

Farmers and ranchers have a two-fold interest in the control and eradication of zoonotic diseases: the tremendous economic loss from diseased animals; and the well-being of their families and the consumers of animal products. Tuberculosis, although of greatly diminished importance in the United States, requires rigorous attention to prevent complacency which would allow the disease to spread. Brucellosis eradication has been highly successful in the United States due to a rigorous eradication program. Leptospirosis, a widely distributed disease occurring in cattle, swine, and dogs as well as rodents, the coon, beaver, and the muskrat, is a confusing disease and its control is far from adequate requiring further research. Trichinosis has been reduced by the cooking of garbage fed to swine thus reducing its incidence in humans. Psittacosis is transmitted by parrots and parakeets, and poultry are known to be infected. The sharp reduction of incidence in the preceding diseases in animals has resulted in a corresponding decrease in incidence in humans. The programs which have effected this result deserve widespread support.

**64-0949**

Anderson, R. J. Public health aspects of the solid waste problem. In Proceedings; National Conference on Solid Waste Research, Chicago, Dec. 2-4, 1963. American Public Works Association, 1964. p.8-11.

The movements of the explosive expansion of the chemical industry, the surging trend toward living in cities or metropolitan areas, and the continued growth of the whole industrial complex, with its accompanying effect on the general environment have aggravated in increasing measure, the problems of water pollution, air pollution, radiation hazards, the need for additional work in occupational health safe guards, restaurant sanitation and general milk and food purity activities, and research into the dangers of the use of pesticides, among others. The most prevalent disposal system of serious danger to health is the open dump, with its flies and rats. Poor refuse handling commonly provides food for flies, cockroaches, and domestic rodents. Open cans and bottles catch and hold water in which mosquitoes can breed, so that many individual citizens unknowingly but actively encourage the proliferation of these disease-carrying pests. The fly infested refuse that is ordinarily collected during warm weather must be carefully handled to prevent fly production. In order to prevent fly emergence by compacting the cover material at sanitary landfills, a California study showed that there were four essential factors to consider: soil that can be compacted, suitable equipment for compacting the soil, adequate range of soil moisture, and adequate thickness of cover.

**64-0950**

Beaver, P. C. Cutaneous larva migrans. Industrial Medicine and Surgery, 33(5):319-321, May 1964.

Cutaneous larva migrans is a form of dermatitis characterized by linear lesions marking the migratory paths of larval parasites. The infective stage occurs most commonly in damp, shaded soil. Hookworm eggs reach the soil in feces, so the infective stage larvae tend to be concentrated at the defecation site. The most important cause of cutaneous larva migrans in this country is believed to be one of the cat hookworms. Since cats bury their feces, they ordinarily select easily excavated defecation sites. Besides the hookworms, there is a group of intestinal nematodes whose larvae develop directly in the fecal mass, or in water. The lesions of these worms are relatively wide and progress remarkably fast, and the worm tends to be inactive for periods of several days or weeks. The skin migration phase of these infections is self-terminating, and is usually followed by larval migration to the lungs or other organs. Freezing or chemical blistering of the epidermis is the only effective means of treatment. As an occupational disease, cutaneous larva migrans is most frequently seen in plumbers, electricians, and construction workers who are required to be in contact with damp or wet soil contaminated with feces of cats or dogs. The only practical preventive measure is avoiding contact with infective soil or water.

**64-0951**
Bonus plan lowers accidents, downtime for California firm. Refuse Removal Journal, 7(1):15, Jan. 1964.

ABCO Disposal Corp. of Gadena, California, has a strict safety program, which has greatly reduced accidents. Some features of the program are monthly bonuses to safe drivers, automatic transmission to relieve the jerking and swinging of the truck containers and drivers' fatigue, and regular inspection of vehicles and personnel to make sure they have donned their safety equipment. This plus a modern efficient accounting system has increased the size of the clientele.

**64-0952**
Clarke, N. A., and P. W. Kabler. Human enteric viruses in sewage. Health Laboratory Science, 1(1):44-50, Jan. 1964.

Viruses causing poliomyletis, hepatitis, meningitis, and diarrhea are excreted in the feces. A hepatitis epidemic was due to sewage contamination of water supply in New Delhi, India. Although any type of enteric virus can be found in sewage, fluctuations in the predominant type of virus detected in sewage apparently occur. Expected density was 700 virus units per 100 ml raw untreated sewage. A maximum density of 20 units per 100 ml during cold and 400 units per 100 ml during warm months were reported. The enteric virus-coliform ratio in sewage is about one to 100,000. The gauze pad sampling technique is superior to grab sampling. Tables show that viruses survived longer at 4 C than at 28 C. Sedimentation in an Imhoff tank for two hours had no destructive action on virus. Sewage treatment does not necessarily destroy Coxsackie virus. Filter effluent contained virus as often as raw sewage. Data indicates that 90 to 98 percent removal or inactivation of virus by activated sludge, an adsorption phenomenon, involves aeration and settling of the floc. Number of viruses increased as sewage passed through the plant. Chlorination reduces the number.

**64-0953**
Clarke, N. A., G. Berg, P. W. Kabler, et al. Human enteric viruses in water: source, survival, and removability. Advances in Water Pollution Research, 2:523-541, 1964.

A survey investigated the problem posed by human enteric viruses in water and sewage. The efficacy of current water and sewage treatment processes in removing or destroying these agents was examined, data was presented, and recommendations were made. The viruses occur at relatively low densities in sewage. Survival times of enteric viruses and indicator bacteria in water depend largely on the nature of the water. Viruses appear to survive longer in water that is relatively unpolluted or grossly polluted. Indicator bacteria survival periods in surface waters appear to be directly related to the water's pollution. The activated sludge process removes 90 to 98 percent of enteric viruses in raw sewage. The flocculation process, using either alum or ferric salts, can remove 95 to 99 percent of Coxsackie A2 viruses from water in single-stage flocculation, or more than 99 percent in double-stage operations. Virus removal parallels removal of bacteria and turbidity. Hypochlorous acid inactivates viruses in water highly affectively. The rate of inactivation depends on the specific virus, pH, temperature, and contact time. Iodine and hypoiodous acid are highly efficient in destroying enteric viruses. A discussion followed presentation of the paper and made three points. Viruses which hardly multiply at all in surface water are related to a faecal contamination of the water. The correlation between the presence of viruses in water and epidemiology is not yet definitely established. Our conception of artificial water purification needs reassessment. The amount of nitrogenous matter discharged into rivers above catchments of water destined for consumption should be reduced.

**64-0954**
Control of external parasites of chickens and pigeons. University of California, Agriculture Extension Service, Feb. 1964. 9 p.

Effective and safe chemical control of the common ectoparasites of chickens and pigeons presents a vital problem. The residues of insecticides could affect the meat and eggs at the time of marketing. To prevent this, several measures have to be taken. All precautions on the insecticide label should be followed for use and storage. Read and follow the label instructions. Avoid inhalation of the insecticide. Do not smoke or eat during application of the insecticide. Change clothing and wash thoroughly immediately after application. Dispose of all mixed unused insecticide sprays and empty containers safely. Burning of combustible containers and washing and destroying the noncombustible ones is recommended. All insecticides should be kept in their original containers and placed in a storage area that can be locked. Do not store them near food, feed, or medication of any kind. Insecticide contamination of eggs, feed, and water should be avoided. Additional data on how to treat chicken and pigeons for mites, ticks, and fleas is given in the report.

**64-0955**

Cutler, J. C., E. C. Chamberlayne, and B. D. Blood. Occupational disease problems with reference to agriculture in Latin America. Continued Education Series No. 124. In Proceedings; Institute on Occupational Diseases Acquired from Animals, Ann Arbor, Michigan, Jan. 7-9, 1964. p.394-430.

A review of the information on acquired diseases of the agriculture industry in Latin America is presented. Anthrax, Brucellosis, Hydatidosis, Leptospirosis, Q fever, Tuberculosis as well as several other diseases of much smaller incidence are considered. Information concerning their incidence in workers in various South American countries is presented by specific location, animals involved, and work carried out by the humans found to be infected. Much statistical information on these topics is tabulated and examined along with maps indicating occurrence. A high health risk is still present for the agriculture industry employees due to the zoonoses which exist in the environment, even where safe water supplies, good sewage disposal, and even mechanized farming exist.

**64-0956**

Dixon, F. R., and L. J. McCabe. Health aspects of wastewater treatment. Journal of the Water Pollution Control Federation, 36(8):984-989, Aug. 1964.

Recent data shows that the explosive manufacturing industry ranks far more favorably than the wastewater industry in injuries from on-the-job accidents. It seems that disease hazards in wastewater treatment plants are of the type that are not clearly recognized as such until disabilities result from them. Fungi potentially pathogenic for man have been isolated from sewage and polluted water. Salmonella infect their hosts through the alimentary tract and are discharged in the feces. Food processing wastes add Salmonella to sewage. Shigella organisms causing leptospirosis, mycobacterium tuberculosis, endamoeba histolytical, and hepatitis virus may be present. Sludge spread on soil may spread infection. Persons occasionally fall into aeration tanks, grit removal basins, or major sewer outfalls. The actual incidence of infectious and parasitic diseases acquired from sewage work is probably not very high. More data is needed on illness among sewage workers and waste treatment plant operators.

**64-0957**

Douse the fire without dumping the load. American City, 79(2):38, Feb. 1964.

Two 2½-in. fire-hose couplings installed on top of refuse truck bodies provide an inexpensive solution to fire problems, according to Edward H. Stelle, Supervisor in the Washington Suburban Sanitary Commission's Refuse Division. In the past, refuse truck drivers promptly dumped the load in the street and called the fire department when they noticed signs of fire coming from the packer unit. This resulted in a messy situation requiring extensive cleanup work. Also, if the fire had already damaged the hydraulic equipment, the load could not be dumped. With hose couplings installed on the top of the bodies, all the firemen have to do is attach their hoses and flood the interior with water. This extinguishes the fire and the truck can proceed to the disposal site with little mess or loss of time.

**64-0958**

Eagen, J. H. Environmental health implications of solid waste disposal. Presented at Western Branch Meeting of the American Public Health Association, Salt Lake City, May 20, 1964. 14 p.

The storage, collection, and disposal of solid wastes is one of the major environmental health problems which presently face urbanized mankind. There are three basic areas in which the environmental health profession can attack the solid waste problem: urban environmental health planning, encouragement of a comprehensive research effort, and application of technical knowledge. This can be accomplished by exhorting local government to recognize and assume its responsibilities to provide adequate collection and disposal by promulgating appropriate statutes, ordinances, and regulations to permit a multi-jurisdictional approach to the problem and formal control over the operational practices. At the present time, only $200,000 per year of public money is going toward research in an area where the annual expenditures for operation approach $3 billion. The application of technical knowledge that is now available to upgrade existing unsatisfactory operations by converting dumps to sanitary landfills and to train operators, particularly in incineration plants, is needed.

**64-0959**
Fire engine at dump site upsets budget. Refuse Removal Journal, 7(11):29, Nov. 1964.

Flash fires and the inability to properly handle the amount of debris delivered to the city dump have caused the authorities of Bayonne, New Jersey to reexamine their entire system of refuse collection and disposal. Since the town is an industrial area and manufacturing waste is sometimes inflammable, the dump would have to be continued in operation if only as a place to dispose of the incinerator residue. The cost of maintaining a fire department unit at the dump site for 12 to 14 hr every day has made the dump too costly for the municipality to run. A suggested solution by the Bayonne City Council president is to hire a private contractor to operate the dump. At present, the Public Works Department is making a study of the future disposal needs of the city.

**64-0960**
Greenburg, B. Experimental transmission of salmonella typhimurium by houseflies to man. American Journal of Hygiene, 80(2):149-156, Sept. 1964.

For this study, a dog drank milk containing 210 x 10 to the eighth power S. typhimurium. Flies were colonized and left unfed immediately before exposure to the dog's feces. Atole, a Mexican drink, was placed in the flies' cages for seven hours. Ten volunteers drank the Atole. Stool specimens were tested. The degree of contamination per fly was low. Five of 20 flies were positive with counts between 43 and 635 S. typhimurium. Eight of the 10 Atole specimens contained S. typhimurium ranging from 5 x 1,000 to 64 x 10,000. S. typhimurium was recovered from the feces of six volunteers. Extension of the experimental standing period for the Atole to 24 hr could have produced a significant infection dose. Virus cannot multiply in food. Bacterial infections can occur through fly contamination of food. Tables show mouse infection-rate and housefly transmission of S. typhimurium.

**64-0961**
Harrell, R. E. The known and unknown of the occupational mycoses. Industrial Medicine and Surgery, 33(5):306-307, May 1964.

Six different mycoses are discussed with respect to their role as occupational hazards. The diseases mentioned are: (1) Histoplasmosis; (2) North American blastomycosis; (3) Coccidioidomycosis; (4) Cryptococcosis; (5) Sporotrichosis; and (6) Candidiasis. Histoplasmosis, caused by Histoplasma capsulatum, can be contracted most readily by contact with chicken feces. For this reason, farmers are among the most susceptible persons. North American blastomycosis, a systemic fungus infection, seems to have no occupational aspect. Most reports indicate that the disease has come from dog bites. Coccidioidomycosis is carried by the Coccidioides immitis spore and is found mainly in the Southwest. Any outdoor profession is therefore vulnerable. Also Negroes have been found to be extremely susceptible. Cryptococcosis, a fungus disease carried in pigeon feces, has little occupational aspects except for people who may clean out areas rich in pigeon manure. Sporotrichosis, which enters the body through open wounds, had its largest outbreak in a mining operation in South Africa where workers were picking it up from splinters in mineshafts. Also susceptible are occupations where minor wounds are frequent. The last of the diseases mentioned, Candidiasis, is most harmful to those whose occupations require an increased exposure of their hands to water.

**64-0962**
Kelly, S., and W. W. Sanderson. Attenuated polioviruses in sewage. Journal of the Water Pollution Control Federation, 36(7):905-913, July 1964.

Twenty-four strains of poliovirus type-1, and nine of type-3 were isolated from sewage collected in the pre-oral vaccine period in Albany, New York and nearby communities. They were examined for temperature (rct) and elution (E) markers for neurovirulence traits. The rct marker was examined by end point titration and limited thermal exposure method. The E market was examined by elution from alumina gel. The rct- designated the strain that was less complete at 40 C than at 37 C. The rct+ was the strain which grew well at either temperature. The rct-markers were present in strain from sewage collected before the oral vaccine. Six type-1 and one type-3 strains were rct- by both methods. One type-3 strain was rct+ by both methods. The remaining strains were rct+ or- by one or both methods or rct+ or rct- by one method only. The rct+ and rct- markers were found in strains from the same sewage sample. There was no evidence that sewage treatment affected the distribution of the rct or E markers. E+ markers indicate attentuation and E- indicates neurovirulence. E+ markers were present in 92 percent of the type-1 and 66 percent of the type-3 strains. They paralleled rct markers determined by EP method in 32 percent of type-1 strains and by LTE method in 89 percent of type-3 strains. Data and tables support conclusions given in this paper.

**64-0963**
Lamb, G. A., D. Y. Chin, and L. E. Scarce. Isolations of enteric viruses from sewage and river water in a metropolitan area. American Journal of Hygiene, 80:320-327, 1964.

The prevalence of enteric viruses in sewage from Chicago and in water samples from the Upper Illinois River was investigated. From 164 sewage and water samples, 122 viruses were recovered. Many of these viruses were polioviruses and coxsackieviruses. Specimens were taken from 12 locations, situated in relation to Chicago's three major sewage treatment plants. Sewage treatment by activated sludge is employed in all the plants. In each plant, four sample areas were selected river water both one mile above and below the plant and raw and treated sewage. Samples were collected by the modified gauze pad method. Specimens were identified and then inoculated into suckling mice. Viruses were contained in 49 percent of the samples. As data demonstrates, virus was detected in 80 percent of raw sewage samples, 52 percent of treated sewage, 6 percent of river water above the plant, and 13 percent of river water below the plant. Samples collected in July and August had the highest frequency of virus recovery month while October had the lowest. Higher raw sewage virus isolation percentages were reported by this study as opposed to others. This may be due to population density, seasonal or yearly variation, prevalence of enterovirus infection in the population, or collection methods. The study also demonstrates that discharging effluent into the river contributes to surface water pollution below the outfall. Besides viruses mentioned earlier, echovirus type 7 was found, probably the cause of much minor illness and subclinical infection in the population. Type 1 reovirus was also discovered.

**64-0964**
Liebmann, H. Parasites in sewage and the possibilities of their extinction. Journal of the Water Pollution Control Federation, 36(3):304, Mar. 1964.

Worm carriers of the human population and domestic animals determine the types and number of parasitic worms and eggs found in sewage. They are introduced through domestic sewage and wastewaters by slaughter houses and meat and fish packing industries into bodies of water. According to the Munich studies, approximately 1 billion worms and/or eggs per day enter cities with one million plus population by means of raw sewage into sewage treatment plants (at least 10 percent originating with humans). Chemical extinction and biological purification of parasites are either unpractical or ineffective. Worms and eggs must be allowed to settle out; then they are removed from the sewage and deposited in sludge where either heating or long-term oxygen deprivation must take place. Sedimentation of sewage and sludge digestion therefore offers the best parasite extinction method.

**64-0965**
McLean, D. M. Contamination of water by viruses. Journal of the American Water Works Association, 56(5):585-591, May 1964.

A recent study has shown that opportunities for the spread of waterborne infections may be provided either by recreational bathing facilities or by public or private drinking water supplies. Swimming pools are operated either as 'overflow-refill' pools in which 5 to 15 percent of pool volume runs to waste daily, or as recirculating pools where water is filtered and then returned to circulation daily. Wading pools are operated as 'fill and draw'- each day the entire volume is removed and replaced with fresh water. As data demonstrates, overflow-refill pools were found to contain more enteric bacteria per day in a low socioeconomic district, but less yearly amassed concentration than a recirculating pool in a higher socioeconomic district. Free chlorine residuals in each pool eliminated all viruses. The disinfectant properties of bromine were examined, and found most satisfactory. Another study revealed higher concentrations of organisms on swimming pools' surfaces than in water 1 ft below the surface. Wading pools showed high indexes of coliform organisms until compounds giving chlorine residuals were added. Though no viruses were recovered, lakeshore studies revealed gross bacterial contamination, containing high coliform organism indexes. Drinking water contamination appears to significantly correspond to infectious hepatitis outbreaks. Following pollution with human sewage, three types of water supply were found to contain the virus. They are: groundwater from springs and wells, cross connections between reticulated services, and river water. Clearly all possible contamination sources of water by sewage should be eliminated. Chlorination is a necessity.

**64-0966**
Mann, U. T., and G. E. Griffin. Cost of safety. Journal of the Water Pollution Control Federation, 36(2):168-175, Feb. 1964.

The cost of setting up a safety program is difficult to evaluate, for neither the expenditure of time and energy, nor the results of such a program, can be measured easily in monetary terms. Good safety programs are essential in reducing the accident-frequency rate, which is considerably higher for sewer departments than for the explosives manufacturing industry. Too often loss of life results from disregarding safety procedures and equipment. The County of Westchester, New York, provides sewage maintenance crews with inexpensive but effective equipment for testing sewer manholes and pump suction wells for hydrogen sulfide, air deficiency, and flammable gas. Deaths are most often due to asphyxiation. Pumping stations or treatment plants can be equipped with safety features at nominal costs. Providing explosion-proof equipment, however, may increase an item's cost by as much as $1,200. Such costs may be minimized by arranging plant units so that hazardous locations are kept to a minimum.

**64-0967**
Ravenholt, R. T. History, epidemiology, and control of typhoid fever in Seattle. Medical Times, 92(4):342-352, Apr. 1964.

Seattle grew rapidly during its first century of existence. This growth overloaded the community's water supplies and waste disposal means, resulting in much morbidity and mortality from enteric diseases, especially typhoid fever. Seattle suffered its worst epidemics in 1889, 1890, 1907, and 1909. Thousands became ill and hundreds died. The greatest mortality rate, 166 per 100,000 population, occurred in 1889 due to a water shortage. The city then received its water supply from various private companies. In 1890, when Seattle established its own Water Department, the major water source also served as an important receptacle for sewage. The ramifications of this system are obvious. Changes were made, but they generally were insufficient to meet the needs. Aggravating this situation, water shortages were making fires a real threat. Seattle thus began vigorous preventive measures in 1911--explaining to citizens the necessity of boiling their water or treating it with chlorine. A new water system was constructed, employing rigorous supervision and chlorination. Due to such planning and vigilance, there has been a dearth of water and milk-borne outbreaks of typhoid during the past 50 years. Similar advances have been made regarding milk, plumbing, sewerage, and immunization. Many advances, for example, have occurred in production methods, processing, and distribution of milk, leading to decreased deaths from diarrhea and enteritis. A Public Health Laboratory has operated since 1901 and stands as an excellent check against future epidemics. Included data provide statistics on disease deaths.

**64-0968**
Sanitation work is most dangerous. In 1964 Sanitation Industry Yearbook. New York, RRJ Publishing Corporation, [1964]. p.28

A year-long study of New York City's sanitation workers reveals that the only occupational category that had a higher percentage of injuries was that of loggers. According to the report, a sanitation worker walks 14 miles and lifts 6 tons every working day.

**64-0969**
Sheppard, P. E. Safety survey analysis. [Chicago] American Public Works Association

and the Association Division of the National Safety Council, Sept. 1964. 11 p.

The purpose of this survey was to determine the present status of safety programs and accident prevention efforts in the area of public employees. A total of 1,872 survey forms were mailed to the mayor or city manager of all U.S. cities with more than 10,000 population. Two hundred and forty (13%) returns containing usable information were received. Cumulative statistics are given. There is much data on accident experience, insurance costs, safety programs, methods used in reporting accidents, etc. There is a breakdown of the injuries within given city-operated departments, i.e. police, fire, hospitals, sanitation. Several tables give the frequency, severity of work injuries, for refuse collection specifically. Also included is the accident record of a sample city (one year experience), listing location of injuries, types of accidents, employee's actions, and paid time lost (workdays).

**64-0970**
Soil-transmitted Helminths. Report of a WHO Expert Committee on Helminthiases. Technical Report Series No. 277. Geneva, World Health Organization, 1964. 70 p.

The public health importance of all helminthic infections is discussed. Geographical distribution, factors influencing transmission, and pathogenesis of diseases caused by these intestinal parasites are reviewed. Interrelations between the host and the parasitic worm are considered, and techniques of study are reviewed. Natural immunity to such infections can be acquired, but research for control of these diseases is recommended. Disposal of night-soil has proven quite successful in preventing the contamination of the soil and the development of the infective stages of the parasites. Control measures are directed towards effective disposal and treatment of feces. In direct disposal methods, it is vitally important that contamination of soil, groundwater, and surface water, does not occur. Excreta should be inaccessible to pests, and should not be handled. The conservancy method of disposal (utilizing human feces as fertilizer) can be dangerous if certain precautions are not taken. Composting ensures aerobic decomposition, a process which hastens the killing of helminth eggs. However, odors produced and disposal of undigested material are serious disadvantages. Sewage disposal methods should be studied for their safety, for agricultural use of sludge is considered by some to be a factor in the transmission of helminths. Techniques for heating of sludge to kill Ascaris and Trichuris eggs may be applicable.

**64-0971**
Strauch, D. Requirements of veterinary hygiene in the removal of urban refuse. International Research Group on Refuse Disposal (IRGRD). Information Bulletin No. 20. Washington, U.S. Department of Health, Education, and Welfare, May 1964. 5 p.

All refuse coming from residences, stores, and commercial and industrial plants is designated as urban refuse. The amount of urban refuse varies widely. Laws almost totally prohibit the dumping of it. Incinerators are one answer to the refuse problem, but their great expense makes them prohibitive. Smaller communities turn increasingly to composting their refuse. Pathogens which endanger the health of man and animals are found in refuse and sewage sludge. The greatest danger lies in animals which are fed infected domestic refuse. Trichinosis is the outstanding example of this. Sewage sludge contains pathogens harmful to man and animal. They settle in the sludge during sewage treatment. It is emphasized that sludge be treated the same as sewage when viewed from the disease standpoint. Tubercle bacillus have been found in dried sewage sludge after two years. It was found through experimentation that it was possible to destroy pathogens by using certain composting methods. Composting of underground refuse with sewage sludge, of ground refuse without sludge, and of refuse with sludge from a stabilizer were the three methods. Composting will be used increasingly in the future.

**64-0972**
Terry, L. L. Health and psychological aspects of the city. Public Health Service Publication No. 1249. Washington, U.S. Government Printing Office, June 1964. 11 p.

Urban planning for health is immensely complex. It involves all the traditional health protective measures—collection and disposal of wastes, control of water and air pollution, protection of food, control of insects and rodents, hygiene of housing—in a constantly changing environment. It is related to problems of topography, traffic flow, zoning, and other matters of urban planning. It calls for cooperative effort among numerous interests, professions, and groups. Technical considerations must be balanced against economic, legal, sociological, and political factors. Above all, urban planning for health calls for widespread public understanding and support. The U.S. Public Health Service has established a Metropolitan Planning and Development Branch which has developed an 'Environmental Health Planning Guide' designed to help communities to evaluate health-related services and facilities from a planning standpoint. The Guide emphasizes long-range planning and deals primarily with air and water pollution, sewerage, refuse collection and disposal, and housing. The professions of architecture and public health have many problems to solve in the future that will involve joint planning and action. (Excerpts from a speech delivered, 96th Annual Convention of the American Institute of Architects, St. Louis, Mo., June 17, 1964.)

**64-0973**
Time to tackle health problems. American City, 79(8):34, Aug. 1964.

At a conference on 'Environmental Health Problems' at the University of Michigan School of Public Health, the problems of water supply sewage, air pollution, and waste disposal were discussed. Since the typical city dweller creates one ton of solid waste annually, and since our expanding population will cause an increase in the total volume of solid wastes, the nation's metropolitan areas will be paralyzed by uncontrollable health problems unless they take immediate measures to cope with trends in the environment. Control measures at the highest practical level of government, and a definite platform on environmental health by each political party are recommended.

**64-0974**
U.S. Public Health Service. Environmental health survey Wayne Township, New Jersey. Cincinnati, July 1964. 66 p.

A course on Urban Planning for Environmental Health was conducted cooperatively with the State of New Jersey Department of Health and the Township of Wayne and brought together health, planning, public works, and industrial personnel and lay citizens. The class conducted an environmental health survey of Wayne Township on June 2 to 4 and 9 to 11, 1964, as a training exercise. The students spent many hours interviewing local people and preparing recommendations. The group reports cover: water services, sewerage services, refuse collection and disposal, housing, air pollution, shore and lake sanitation, general sanitation, and planning. A student roster and a list of staff participants is appended.

**64-0975**
U.S. Public Health Service. Food-borne disease investigation: analysis of field data. Washington, U.S. Government Printing Office, 1964. 34 p.

Diarrhea and abdominal cramps are the dominant symptoms in Salmonella gastroenteritis. They are usually accompanied by vomiting, chills, and fever. Salmonella bacteria are found in the intestines of almost all poultry and hogs. They are, therefore, transmitted in animal food products, or by certain other foods that come in contact with them. Salmonellae may also be transmitted by infected humans who do not wash their hands well after a bowel movement, and who then handle food. Salmonellosis is rarely fatal except in elderly people. When proper sanitary operating procedures are applied, outbreaks can be controlled.

**64-0976**
Wastes endanger country's health. Refuse Removal Journal, 7(5):14, May 1964.

Norman E. Tucker of the U.S. Public Health Service in Cincinnati, Ohio, and Prof. Morton S. Helbert of the University of Michigan School of Public Health said that the nation's metropolitan areas will paralyze themselves with uncontrollable health problems unless they take immediate measures to cope with trends in the environment. They spoke at a conference on 'Environmental Health Problems' at the University of Michigan in Ann Arbor.

**64-0977**
Weibel, S. R., F. R. Dixon, R. B. Weider, et al. Waterborne-disease outbreaks, 1946-1960. Journal of the American Water Works Association, 56(8):947-958, Aug. 1964.

During the period 1946 to 1960, there were 228 disease outbreaks or poisonings attributed to drinking water. It appears, despite incomplete reporting, that there has been a consistent downward trend in the number of waterborne-disease outbreaks. Infectious hepatitis is definitely accepted as a waterborne disease. A 7 to 9 year, besides a seasonal, cycle can be recognized. Most epidemics and cases of waterborne diseases were classified as gastroenteritis. This category and 'diarrhea' are not specific diseases. Typhoid, being a recognized, severe disease was well reported. It caused 39 outbreaks with 506 cases. Water utilities in America do a tremendous job in producing safe water and preventing waterborne disease. The annual rates of illnesses are nearly the same for public and private supplies. Within the periods 1920 to 36 and 1938 to 45, untreated groundwater most frequently caused outbreaks. During this study period, public supplies caused 31 percent of outbreaks and 77 percent of cases; private 69 percent and 23 percent. In private supplies source pollution and untreated water produced the major harm, the biggest problem being well pollution. Inadequate treatment control created the majority of public supplies' diseases. Peaking of outbreaks for private supplies occurred during summer months, probably resulting from increased numbers of susceptible individuals utilizing normally polluted water. Facilities serving more than 100,000 people accounted for less than 1 percent of cases, but 10 percent of outbreaks. Untreated water, employed by 8.6 percent of the population, cause 35 percent of disease among these people.

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